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ORDINANCE 122370

AN ORDINANCE relating to environmentally critical areas, amending Seattle Municipal Code Sections 25.09.015, 25.09.020, and 25.09.030 to address the findings of the Central Puget Sound Growth Management Hearings Board.

WHEREAS, the Central Puget Sound Growth Management Hearings Board upheld the appeal of Ordinance 122050 with respect to designating certain seismic hazards (the Seattle Fault zone area, areas susceptible to tsunami inundation, and areas susceptible to seiches) and volcanic hazards (areas susceptible to inundation by lahars or related flooding from volcanic activity on Mount Rainier); and

WHEREAS, the Central Puget Sound Growth Management Hearing Board denied the appeal of Ordinance 122050 with respect to requiring additional regulations to protect those seismic and volcanic hazard areas; and

WHEREAS, the City of Seattle has engaged in public participation and has included the best available science in designating these seismic and volcanic hazard areas, has considered the Guidelines adopted by the Washington State Department of Community Trade and Economic Development for designating geologically hazardous critical areas, and has considered the goals of the Growth Management Act, all as set out in the Supplemental Best Available Science Report for Geologically Hazardous Areas, attached as Exhibit A, and in the Director's Report; NOW, THEREFORE,

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. Subsection A of Section 25.09.015 of the Seattle Municipal Code, which Section was enacted by Ordinance 122050, is amended as follows:

25.09.015 Application of chapter.

A. This chapter applies to any development, as defined in Section 25.09.520, or platting carried out by any person on publicly or privately owned parcels containing an environmentally critical area or buffer, <u>except that parcels that are solely within seismic or volcanic hazards areas,</u>

as defined in Sections 25.09.020 A5 and 25.09.020 A6, and that are not liquefaction-prone areas are subject only to Sections 25.09.010, 25.09.017 A, B, C and F, 25.09.020, and 25.09.030.

Section 2. Section 25.09.020 of the Seattle Municipal Code, which Section was last amended by Ordinance 122050, is amended as follows:

25.09.020 Environmentally critical areas definitions.

The following are environmentally critical areas ((~~regulated~~))designated by this chapter: geologic hazard areas, steep slope areas, flood-prone areas, wetlands, fish and wildlife habitat conservation areas, and abandoned landfills.

A. Geologic Hazard Areas and Steep Slope Areas.

1. Geologic hazard areas are liquefaction-prone areas,((~~and~~)) landslide-prone areas, seismic hazards areas and volcanic hazard areas described in subsections 2, ((~~and~~))3, 5 and 6. Landslide-prone areas include steep slope areas. Steep slope areas that are regulated for additional erosion hazards are described in subsection 4. ((~~Seismic hazards are addressed in subsection 5.~~))

2. Liquefaction-prone Areas. Liquefaction-prone areas are areas typically underlain by cohesionless soils of low density, usually in association with a shallow groundwater table, that lose substantial strength during earthquakes.

3. Landslide-prone Areas. The following are landslide-prone areas:

a. Known landslide areas identified by documented history, or areas that have shown significant movement during the last ten thousand (10,000) years or are underlain by mass wastage debris deposited during this period; or

b. Potential landslide areas:

(1) Those areas that are described as potential slide areas in "Seattle Landslide Study" (Shannon & Wilson, 2000((~~,~~)) and 2003)((~~, or as are more accurately mapped~~)).

(2) Areas with indications of past landslide activity, such as landslide headscarps and sidescarps, hummocky terrain, areas with geologic conditions that can promote earth movement, and areas with signs of potential landsliding, such as springs, groundwater seepage, and bowed or backtilted trees.

(3) Areas with topographic expression of runout zones, such as fans and colluvial deposition at the toes of hillsides.

(4) Setbacks at the top of very steep slopes or bluffs, depending on soil conditions.

(5) Slopes with an incline of forty (40) percent or more within a vertical elevation change of at least ten feet (10').

For the purpose of this definition, a slope is measured by establishing its toe and top and averaging the inclination over at least ten feet (10') of elevation difference.

Also for the purpose of this definition:

(a) The "toe" of a slope means a distinct topographic break in slope that separates slopes inclined at less than forty percent (40%) from slopes inclined at forty percent (40%) or more. Where no distinct break exists, the "toe" of a slope is the lower-most limit of the area where the ground surface drops ten feet (10') or more vertically within a horizontal distance of twenty-five feet (25'); and

(b) The "top" of a slope is a distinct topographic break in slope that separates slopes inclined at less than forty percent (40%) from slopes inclined at forty percent (40%) or more. Where no distinct break exists, the "top" of a slope is the upper-most limit of the area where the ground surface drops ten feet (10') or more vertically within a horizontal distance of twenty-five feet (25').

(6) Areas that would be covered under one of subsections (2) to (5), but where the topography has been previously modified through the provision of retaining walls or non-engineered cut and fill operations;

(7) Any slope area potentially unstable as a result of rapid stream incision or stream bank erosion.

4. Steep Slope Areas. Steep slope areas are areas with a slope described in subsection A3b(5) above; provided that ((~~the area is only a landslide prone area~~)) when such a slope is on a parcel in a Downtown zone or highrise zone, the area is designated only as a landslide prone area.

5.((~~There is a known risk from a seismic events in Seattle and the surrounding region. Subsection 1-4 identify areas that constitute a particularly high risk to safety and welfare from such events and are therefore regulated as environmentally critical areas. The risks associated with seismic hazards in the remainder of the City are regulated by the Building Code (SMC Title 22) and not by this Ordinance [Chapter].~~))

Seismic Hazard Areas.

In addition to liquefaction-prone areas described in subsection 2 above, seismic hazard areas are the following:

a. Areas of the City subject to ground shaking from seismic hazards that are addressed by the Building Code (SMC Title 22).

b. The Seattle Fault zone as delineated in Troost et al., 2005, *The geologic map of Seattle, a progress report, U.S. Geological Survey, Open-file report 2005-1252* or as the Director determines is more accurately mapped by the U.S. Geological Survey, as set out in a Director's Rule.

c. For tsunamis the waterbody of Lake Washington and for tsunamis and tsunami inundation, the water body and land area as shown in Walsh, et al., 2003, *Tsunami hazard map of the Elliott Bay area, Seattle, Washington: Modeled tsunami inundation from a Seattle Fault earthquake, Washington State Department of Natural Resources and National Oceanic and Atmospheric Administration. Washington Division of Geology and Earth Resources Open File Report 2003-14*, or as the Director determines are more accurately mapped by the National Oceanic and Atmospheric Administration, the U.S. Geological Survey or the Washington State Department of Natural Resources, as set out in a Director's Rule.

d. The shoreline and upland areas surrounding Lake Washington are classified as an unknown risk from tsunamis under WAC 365-190-080 (4)(b)(iii).

e. For seiches, the waterbodies of Elliot Bay, Lake Union and Lake Washington.

f. The shoreline and upland areas surrounding the waterbodies in subsection (e) are classified as an unknown risk from seiches under WAC 365-190-080 (4)(b)(iii).

6. Volcanic Hazard Areas. Volcanic hazard areas are areas subject to inundation by lahars or related flooding resulting from volcanic activity on Mount Rainier, as delineated by the U.S. Geological Survey in Hoblitt, et.al, 1998, *Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428*, or as the Director determines are more accurately mapped by the U.S. Geological Survey, as set out in a Director's Rule.

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Section 3. Subsection 25.09.030 A, which was enacted by Ordinance 122050, is amended as follows:

25.09.030 Location of environmentally critical areas and buffers.

A. Environmentally critical areas are defined in Section 25.09.020, and buffers are described in Sections 25.09.160, 25.09.180, and 25.09.200B. Environmentally critical areas are mapped whenever possible. Except for the maps adopted as designations for geologically hazardous areas in subsections 25.09.020 A5 and 6, ((~~T~~))these maps are advisory. The Director may update or amend the maps by Director's Rule.

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Section 4. When the Director of the Department of Planning and Development finds the best available science is available to determine the presence or absence of a geologic hazard that is currently classified as an unknown risk, the Director shall present that science to the City Council.

Section 5. This ordinance shall take effect and be in force thirty (30) days from and after its approval by the Mayor, but if not approved and returned by the Mayor within ten (10) days after presentation, it shall take effect as provided by Municipal Code Section 1.04.020.

Passed by the City Council the 2nd day of April, 2007, and signed by me in open session in authentication of its passage this 2nd day of April, 2007.

President ________ of the City Council

Approved by me this 6th day of April, 2007.

Gregory J. Nickels, Mayor

Filed by me this 6th day of April, 2007.

City Clerk

(Seal)

Exhibit A: Supplemental Best Available Science Report For Geological Hazard Areas

Chapter 18E.10

GENERAL PROVISIONS

Sections:

18E.10.010 Authority.

This Title is established pursuant to RCW 36.70A, RCW 86.16, WAC 173-22, and Pierce County Resolution No. R91-9. (Ord. 2004-56s § 4 (part), 2004)

18E.10.020 Title.

This Title shall be known as "Title 18E, Development Regulations - Critical Areas." (Ord. 2004-56s § 4 (part), 2004)

18E.10.030 Purpose.

Erosion, landslide, seismic, volcanic, mine, and flood hazard areas; streams; wetlands; certain fish and wildlife species and habitat; and aquifer recharge areas constitute critical areas. All of these areas are of special concern to the people of Pierce County and the State of Washington. The purpose of this Title is to protect critical areas of Pierce County from the impacts of development and protect development from the impacts of hazard areas by establishing minimum standards for development of sites which contain or are adjacent to identified critical areas and thus promote the public health, safety, and welfare by:

A. Avoiding impacts to critical areas;
B. Mitigating unavoidable impacts by regulating development;
C. Protecting from impacts of development;
D. Protecting the public against losses from:
   1. Costs of public emergency rescue and relief operations where the causes are avoidable; and

2. Degradation of the natural environment and the expense associated with repair or replacement.

E. Preventing adverse impacts on water availability, water quality, wetlands, and streams;
F. Protecting unique, fragile, and valuable elements of the environment, including critical fish and wildlife habitat;
G. Providing County officials with sufficient information to adequately protect critical areas and proposed development when approving, conditioning, or denying public or private development proposals;
H. Providing the public with sufficient information and notice of potential risks associated with development in natural hazard critical areas; and
I. Implementing the goals and requirements of the Growth Management Act of 1990, the State Environmental Policy Act, the Puget Sound Water Quality Management Plan, the Pierce County Charter, the Pierce County Comprehensive Plan, and all updates and amendments, functional plans, and other land use policies formally adopted by Pierce County.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.040 Interpretation.

In the interpretation and application of this Title, all provisions shall be:

A. Considered the minimum necessary;
B. Liberally construed to serve the purposes of this Title; and
C. Deemed neither to limit nor repeal any other powers under State statute.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.050 Applicability.

A. This Title shall apply to all lands or waters within unincorporated Pierce County that are designated as critical areas by Pierce County.
B. No development shall hereafter be constructed, located, extended, converted, or altered or land subdivided without full compliance with the terms of this Title.
C. When the requirements of this Title are more stringent than those of other Pierce County codes and regulations, including the Uniform Building Code, the requirements of this Title shall apply.
D. Compliance with these regulations does not remove an applicant's obligation to comply with applicable provisions of any other Federal, State, or local law or regulation.
E. Criteria for determining critical areas is contained within each Chapter of this Title.
F. When a site contains two or more critical areas, the minimum standards and requirements for each identified critical area as set forth in this Title shall be applied.
G. Critical areas, as defined and regulated by this Title, are identified on the following Pierce County Critical Areas Atlas Maps:
   1. County Wetland Inventory Maps;
   2. Landslide Hazard Area Maps;
   3. Erosion Hazard Area Maps;
   4. Seismic Hazard Area Maps;
   5. Volcanic Hazard Area Maps;
   6. Mine Hazard Area Map;
   7. Aquifer Recharge and Wellhead Protection Areas Maps;
   8. Fish and Wildlife Habitat Area Maps; and
   9. Flood Hazard Area Maps.

H. The exact boundary of each critical area depicted on the Critical Areas Atlas Maps is approximate and is intended only to provide an indication of the presence of a critical area on a particular site. Additional critical areas that have not been mapped may be present on a site. The actual presence of a critical area or areas and the applicability of these regulations shall be determined based upon the classification or categorization criteria and review procedures established for each critical area.
I. The Pierce County Critical Areas Atlas Maps shall be updated and maintained by the Cartography Laboratory of the Planning and Land Services Department.
J. Development of the Pierce County Critical Areas Atlas Maps were derived from the sources listed in 18E.10.140 - Appendix A. These sources may be updated from time to time and will result in a correlating update to the applicable Critical Areas Atlas Maps.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.060 Definitions.

See Chapter 18.25 for a complete list of defined terms. (Ord. 2004-56s § 4 (part), 2004)

18E.10.070 Administration.

A. **Approvals Required.** An approval must be obtained from Pierce County when the Department determines that the site or project area may contain a critical area or its buffer, as set forth in each Chapter.
B. **Application Requirements.**
   1. **Preliminary Review.** The provisions for conducting a preliminary review for an application is set forth in Chapter 18.40, Development Regulations - General Provisions.
   2. **Application Filing.**
      a. Applications shall be reviewed for completeness in accordance with Department submittal standards checklists and pursuant to Chapter 18.40, Development Regulations - General Provisions.
      b. The County shall maintain a roster of consultants (e.g., wetland specialists, fish and wildlife biologists, etc., except those professionals who are licensed by the State of Washington such as engineers, geologists and surveyors) who are eligible to submit applications and accompanying assessments, reports, studies, evaluations, delineations, verifications, surveys, etc. as required under this Title. A consultant may be removed from the County's eligibility roster (i.e., given an ineligibility status) for a time period of not less than six months nor greater than twelve months when the Director determines that the consultant knowingly or repeatedly (three times) submits inaccurate assessments, reports, plans, surveys, certification forms, etc. The consultant will be informed in writing of the County's decision for removal from the roster, the time period for such removal, and appeal procedures.
   3. **Modifications.**
      a. The Department may request an update of any required assessment, report, delineation, study, etc. due to the potential for change in the existing environment that may have been caused by a natural event (e.g., seismic event, landslides, flooding, etc.) that occurred after the original document was initially submitted but prior to the Department granting issuance of the permit or approval.

b. The request to update any required assessment, report, delineation, study, etc. shall be utilized when there is a potential for life safety issues that may occur as a result of the natural event (e.g. increased potential for landslide).
c. The Department shall request any required updates in writing.

C. **Public Notice.** Public notice provisions for notice of application; public hearing, if applicable; and final decision pursuant to this Title are outlined in Chapter 18.80, Development Regulations - General Provisions.

D. **Review.**

1. **Initial Review.** The Department shall conduct an initial review of any application in accordance with the provisions outlined in Chapter 18.60, Development Regulations - General Provisions.
2. **Review Responsibilities.**
   a. The Department is responsible for administration, circulation, and review of any applications and approvals required by this Title.
   b. The Examiner shall be the decision authority for any approval under this Title requiring a public hearing, including, but not limited to Reasonable Use Exceptions and Variances.
   c. Other County departments and State agencies, as determined by the Department, may review an application and forward their respective recommendations to the Director or Examiner, as appropriate.
3. **Review Process.**
   a. The Department shall perform a critical area review for any application submitted for a regulated activity, including but not limited to those set forth in Section 18E.20.020. Reviews for multiple critical areas shall occur concurrently.
   b. The Department shall, to the extent reasonable, consolidate the processing of related aspects of other Pierce County regulatory programs which affect activities in regulated critical areas, such as subdivision or site development, with the approval process established herein so as to provide a timely and coordinated review process.
   c. As part of the review of all development or building-related approvals or permit applications, the Department shall review the information submitted by the applicant to:
      (1) Confirm the nature and type of the critical area and evaluate any required assessments, reports, or studies;
      (2) Determine whether the development proposal is consistent with this Title;
      (3) Determine whether any proposed alterations to the site containing critical areas are necessary; and
      (4) Determine if the mitigation and monitoring plans proposed by the applicant are sufficient to protect the public health, safety, and welfare consistent with the goals, purposes, objectives, and requirements of this Title.
   d. When it is determined that regulated activities subject to SEPA (Title 18D, PCC) are likely to cause a significant, adverse environmental impact to the critical areas identified in this Title that cannot be adequately mitigated through compliance with this Title, mitigation measures may be imposed consistent with the procedures established in 18D.40.060.

e. Critical area applications required under this Title shall be approved prior to approval of any related action (parent application) such as, but not limited to, a building permit, land division action, site development action, forest practice application, TPCHD permit, use permit, or shoreline permit.

f. The requirement to submit critical area assessments, reports, etc. required under this Title may be waived at the Department's discretion when the proposed project area for a regulated activity is located in an area that has been the subject of a previously submitted and approved assessment, report etc. if all of the following conditions have been met:

(1) The provisions of this Title have been previously addressed as part of another approval.

(2) There has been no material change in the potential impact to the critical area or required buffer since the prior review.

(3) There is no new information available that is applicable to any critical review of the site or particular critical area.

(4) The permit or approval has not expired or, if there is no expiration date, no more than five years have elapsed since the issuance of that permit or approval.

4. **Approval.**

a. Pierce County may approve, approve with conditions, or deny any development proposal in order to comply with the requirements and carry out the goals, purposes, objectives and requirements of this Title. Approval or denial shall be based on the Department's or Examiner's, as applicable, evaluation of the ability of any proposed mitigation measures to reduce risks associated with the critical area and compliance with required standards.

b. Applicants shall comply with the recommendations and/or mitigation measures contained in final approved assessments or reports and any Department or Examiner conditions of approval.

c. Approval of an application required under this Title must be given prior to the start of any development activity on a site.

5. **Denial.** The Department or Examiner, as applicable, shall have the authority to deny any application for development or building-related approvals or permits when the criteria established in this Title have not been met.

6. **Time Period for Final Decision.** The provisions for issuing a notice of final decision on any application filed pursuant to this Title are set forth in Chapter 18.100, Development Regulations - General Provisions.

E. **Time Limitations.**

1. **Expiration of Approval.**

a. Approvals granted under this Title shall be valid for the same time period as the underlying permit (e.g. preliminary plat, site development, building permit). If the underlying permit does not contain a specified expiration date then approvals granted under this Title shall be valid for a period of three years from the date of issue, unless a longer or shorter period is specified by the Department.

b. The approval shall be considered null and void upon expiration, unless a time extension is requested and granted as set forth in subsection 2. below.

2. **Time Extensions.**

a. The applicant or owner(s) may request in writing a one-year extension of the original approval.

b. Knowledge of the expiration date and initiation of a request for a time extension is the responsibility of the applicant or owner(s).
c. A written request for a time extension shall be filed with the Department at least 60 days prior to the expiration of the approval.
d. Upon filing of a written request for a time extension, a copy shall be sent to each party of record together with governmental departments or agencies that were involved in the original approval process. By letter, the Department shall request written comments be delivered to the Department within 30 days of the date of the letter.
e. Prior to the granting of a time extension, the Department may require a new application(s), updated study(ies), and fee(s) if:
   (1) The original intent of the approval is altered or enlarged by the renewal;
   (2) If the circumstances relevant to the review and issuance of the original approval have changed substantially; or
   (3) If the applicant failed to abide by the terms of the original approval.
f. If approved, the one-year time extension shall be calculated from the date of granting said approval.
g. The Director has the authority to grant or deny any requests for time extensions based upon demonstration by the applicant of good cause for the delay.

F. **Recording.**
1. **Approvals.**
   a. Approvals issued pursuant to this Title shall be recorded on the title of the project parcel(s) at the Pierce County Auditor's Office prior to issuance of any site development permits or building permits, as applicable. Failure to record an approval in this timeframe may result in the imposition of enforcement actions. Also refer to Section 18E.10.080 C., Title and Plat Notification, for additional recording requirements.
   b. Recording of critical area approvals for work completed within utility line easements on lands not owned by the jurisdiction conducting the regulated activity shall not be required.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.080 Critical Area Protective Measures.

A. **General.** All critical area tracts, conservation easements, land trust dedications, and other similarly preserved areas shall remain undeveloped in accordance with the conditions of approval, except as they may be allowed to be altered pursuant to each Chapter.

B. **Financial Guarantees.**
1. Pierce County may require an applicant to submit one or more financial guarantees to the County, as set forth in each Chapter, to guarantee any performance, mitigation, maintenance, or monitoring required as a condition of permit approval. The approval for the project will not be granted until the financial guarantee is received by the Department. Projects where Pierce County or one of its departments is the applicant shall not be required to post a financial guarantee.
2. Financial guarantees required under this Title shall be:
   a. In addition to the site development construction guarantee required in Title 17A, Construction and Infrastructure Regulations – Site Development and Stormwater Drainage Appendix.

b. Submitted on financial guarantee forms found in Title 17A, Construction and Infrastructure Regulations - Site Development and Stormwater Drainage Manual.
c. In the amount of 125 percent of the estimate of the cost of mitigation or monitoring to allow for inflation and administration should the County have to complete the mitigation or monitoring, unless the provisions set forth in 18E.10.080 C. below are applicable.
d. Released by the County only when County officials have inspected the site(s) and the applicant's appropriate technical professional has provided written confirmation that the performance, mitigation, or monitoring requirements have been met.

C. **Title and Land Division Notification.**

1. **General.**
   a. Title and/or land division notice shall be required to be recorded with the Pierce County Auditor on each site that contains a critical area, prior to approval of any regulated activity on a site.
   b. If more than one critical area subject to the provisions of this Title exists on the site, then one notice, which addresses all of the critical areas, shall be sufficient.
   c. Title and land division notifications and notes shall be approved by the Department and shall be consistent with 18E.10.140 - Appendix B.
2. **Title Notification.**
   a. When Pierce County determines that activities not exempt from this Title are proposed, the property owner shall file a notice with the Pierce County Auditor. The notice shall provide a public record of the presence of a critical area and associated buffer, if applicable; the application of this Title to the property; and that limitations on actions in or affecting such critical area and associated buffer, if applicable, may exist.
   b. The notice shall be notarized and shall be recorded with the Pierce County Auditor prior to approval of any regulated use or activity for the site.
   c. Notice on title is not required for utility line easements on lands not owned by the jurisdiction conducting the regulated activity (e.g., gas pipelines).
3. **Land Division Notification and Notes.** The applicant shall include notes, as referenced in 18E.10.140 - Appendix B, on the face of any proposed final plat, binding site plan, large lot, and short subdivision documents for projects that contain critical areas or critical area buffers. The applicant shall also clearly identify the critical area boundaries and the boundary of any associated buffers on the face of these documents.

D. **Tracts and other Protective Mechanisms.** Prior to final approval of any subdivisions, short subdivisions, large lot divisions, or binding site plans, the part of the critical area and required buffer which is located on the site shall be placed in a separate tract or tracts. (See Figure 18E.10-2 in Chapter 18E.120), or alternative protective mechanism such as a protective easement, public or private land trust dedication, or similarly preserved through an appropriate permanent protective mechanism as determined by Pierce County. Approval of an alternative protective mechanism will be based upon the Department's or Hearing Examiner's, as applicable, determination that such alternative mechanism provides the same level of permanent protection as designation of a separate tract or tracts. Each lot owner within the subdivision, short plat, large lot, or binding site plan shall have an individual taxable interest in the tract(s) or protective mechanism created by this Section.

E. **Homeowners Covenants.** A description of the critical area and required buffer shall be placed in any required homeowners' covenants. Such covenants shall contain a detailed description of the allowable uses within the critical area and, if applicable, associated buffer and long-term management and maintenance requirements.

F. **Identification of Critical Areas and Required Buffers on Construction Plans.** Critical areas and required buffers shall be clearly identified on all construction plans such as, but not limited to, site development plans, residential building plans, commercial building plans, forest harvest plans, conversion option harvest plans, etc.

G. **Markers, Fencing, and Signage.**

1. **Markers.** The Department may require the outer edge of the critical area boundaries or, if applicable, required buffer boundaries on the site to be flagged by the qualified professional, as outlined in each Chapter. These boundaries shall then be identified with permanent markers and located by a licensed surveyor, unless otherwise stated in this Title. The permanent markers shall be clearly visible, durable, and permanently affixed to the ground.
2. **Fencing.**
   a. **Temporary Construction Fencing.** Temporary fencing is required when vegetation is to be retained in an undisturbed condition within the critical area and required buffer. In such cases, the applicant will be required to construct silt fencing, construction fencing, or other County approved method of temporary fencing at the edge of the critical area or, if applicable, the edge of the required buffer prior to beginning construction on the site. Temporary fencing shall not be required when alteration to a critical area or the buffer is allowed.
   b. **Permanent Fencing.** The Department may require the construction of permanent fencing along the buffer boundary of a wetland, fish or wildlife habitat conservation area or active landslide hazard area.
3. **Signage.**
   a. The Department may require permanent signage to be installed at the edge of the critical area or, if applicable, the edge of the required buffer.
   b. When a sign is required, it shall indicate the type of critical area and if the area is to remain in a natural condition as permanent open space.
   c. Exact sign locations, wording, size, and design specifications shall be established by the Department. Required signage shall be clearly visible, durable, and permanently affixed to the ground.
   d. Prior to final approval of any critical area application, the applicant shall submit an affidavit of posting to the Department as proof that any required signs were posted on the site.

H. **Building Setbacks.**

1. Unless otherwise provided in this Title, buildings and other structures shall be set back a distance of 15 feet from the edge of all critical area buffers or, where no buffers are required, the edge of the critical area.
2. The following uses and activities may be allowed in the building setback area:
   a. Landscaping;
   b. Uncovered decks;
   c. Building overhangs if such overhangs do not extend more than 18 inches into the setback area;

d. Impervious ground surfaces, such as driveways, parking lots, roads, and patios, provided that such improvements conform to the water quality standards set forth in Title 17A and that construction equipment does not enter the buffer during the construction process; and
e. Clearing and grading.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.090 Reconsideration and Appeal Procedures.

Procedures for appeal of an administrative decision and procedures for reconsideration or appeal of a Hearing Examiner decision issued pursuant to this Title are set forth in Chapter 1.22 PCC. (Ord. 2004-56s § 4 (part), 2004)

18E.10.100 Fees.

Fees for applications and/or review of reports, studies, or plans filed pursuant to this Title are set forth in Chapter 2.05 PCC. (Ord. 2004-56s § 4 (part), 2004)

18E.10.110 Compliance.

A. The regulations for compliance with the provisions of this Title are set forth in Chapter 18.140, Development Regulations - General Provisions.
B. When a critical area or its required buffer has been altered in violation of this Title, the Department shall require the property owner to bring the site into compliance. The property owner shall be required to submit the appropriate critical area application and commence review, as applicable for each Chapter. In addition to any required site investigation, delineations, assessments, reports, etc., the property owner shall be required to submit a restoration plan that identifies the proposed mitigation to bring the subject property into compliance with the requirements of this Title.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.120 Warning and Disclaimer of Liability.

To promote public health, safety, and welfare, this Title provides the minimum standards for development of sites which contain or are adjacent to identified critical areas. The minimum standards are deemed to be reasonable for regulatory purposes and are based on scientific and engineering considerations. However, natural and manmade events that exceed the scope regulated under this Title may include but are not limited to: erosion of land, landslides, seismic and volcanic activity, mining, and flooding. Such events may cause serious personal or bodily injury, including death, and damage to or loss of property. The minimum standards in this Title are not a guarantee against damage or injury. Applicants under this Title are responsible for fully investigating and making their own assessment of all potential risks, harm, and dangers that may be present in or near their site and are free to exceed the established standards if they choose.

(Ord. 2004-56s § 4 (part), 2004)

18E.10.130 Severability.

If any provision of this Title or its application to any person or circumstance is held invalid, the remainder of this regulation or the application of the provision to other persons or circumstances shall not be affected.

18E.10.140 Appendices.

A. Mapping Sources.
B. Title and Plat Notification/Plat Notes.
C. Forfeiture of Financial Guarantees.

18E.10.140 - Appendix B
Title and Plat Notification/Plat Notes

A. **Notice for Title Notification.**

<u>(EXAMPLE: WETLAND AND/OR WETLAND BUFFER NOTICE)</u>

Tax Parcel Number:

Address:

Legal Description:

Present Owner:

NOTICE: This property contains <u>(example: wetlands or wetland buffers)</u> as defined by Title 18E, Pierce County Code. The site was the subject of a development proposal for ____ application number ________ filed on ____________ (date). Restrictions on use or alteration of the site may exist due to natural conditions of the property and resulting regulations. Review of such application has provided information on the location of the <u>(example: wetland or wetland buffers)</u> and any restriction on use.

____________________ ____________________

Date Signature of owner

Notary acknowledgment and notary seal

B. **Additional Title Notification Statements.**

1. Title notification for liquefaction and dynamic settlement hazard areas shall include a statement of the performance criteria (i.e., protection of life safety only, provision for minimal structural damage so that post-earthquake functionality is substantially unchanged, no structural damage for the design earthquake).
2. Title notification for fault rupture hazard areas shall include a statement that a fault rupture hazard area or associated buffer exists on the site. The title notification shall include a site plan of the subject property with the fault rupture hazard area and associated buffer identified.
3. Properties that contain flood hazard areas shall include the following statement: "Flood Elevation Certificates are kept on file at the Department of Planning and Land Services."

Supplemental Best Available Science Report For Geological Hazard Areas

The report was prepared by Susan Chang Ph.D. in Civil Engineering, P.E. and Brennon Staley MUP in urban planning, and reviewed by Dr. Kathy Troost, research scientist in Earth and space sciences, University of Washington.

Seattle Fault Zone

Background

A fault is a fracture in the earth along which rocks on one side have moved relative to those on the other side. An earthquake is generated when stress exceeds the available resistance along the fault, resulting in sudden movement and release of energy. When faults occur at the surface, they are called surface faults or shallow crustal faults. If a fault has moved in the past 10,000 years (Holocene) and/or generated an earthquake, it is considered geologically "active". Some faults are buried deep in the earth and some break through to the ground surface. Not all earthquakes result in surface rupture, and not all surface rupture occurs along pre-existing faults.

Prior to the 1990's, shallow crustal earthquakes had not been attributed to specific faults in the Puget Sound region, and no evidence of Holocene fault rupture had been observed. Yount and Gower mapped an east-west trending thrust fault in Seattle in 1991. Known as the Seattle Fault, it forms the boundary between uplifted Tertiary bedrock of the Seattle uplift on the south and thick Quaternary strata in the Seattle basin on the north. This offset produces a large gravity anomaly that was first identified by Danes et al. in 1965.

Bucknam et al. (1992) and Atwater and Moore (1992) discovered the first evidence that the Seattle Fault is active and capable of producing earthquakes that may result in ground surface rupture—a magnitude 7.0 or greater earthquake approximately 1100 years ago resulted in as much as 7 meters of uplift at Restoration Point on Bainbridge Island, creating marine terraces; over 4 meters of uplift at Alki Point, creating an uplifted beach platform; and 1 to 1.5 meters of subsidence at West Point. This earthquake also generated a tsunami in Puget Sound.

Effects of Surface Rupture

Surface rupture due to fault movement results in sudden differential movement at the ground surface. Buildings, transportation infrastructure, utilities, and any structures built above or adjacent to the surface rupture can be severely damaged by the changes in ground elevation and the accompanying ground shaking. Previous earthquakes with ground surface rupture have caused loss of ground support beneath portions of buildings, collapsed bridge spans, broken utility lines, and failure of retaining walls. These types of failures contribute to loss of life and hamper emergency response following an earthquake.

Recent Studies of the Seattle Fault Zone

The Seattle Fault was defined as a "zone" by Johnson et al. in 1994 with four south-dipping strands with reverse displacement. Since then, the subsurface geometry and activity of the Seattle Fault Zone has been the subject of a number of recent studies. Many details about its precise location, subsurface geometry, displacement history, and slip rate are still being debated by researchers, and a number of models have been proposed. Table 1 summarizes recent published studies with postulated proposed models of the Seattle Fault Zone available as of January 2007. The most recent research shows the Seattle Fault Zone as a 5 to 7 km-wide east-west trending zone of south-dipping thrust faults, north-dipping backthrusts, and folds.

The earliest models of the Seattle Fault Zone were based on inferences from gravity data and conventional industry seismic reflection data. Subsequently, more detailed studies have been performed that include aeromagnetic surveys, seismic reflection surveys as part of the 1998 Seismic Hazards Investigation in Puget Sound (SHIPS) experiments, geologic evidence from fault trenching, and geologic mapping.

Stratigraphic and geomorphic evidence support the conclusion that strands of the Seattle fault as mapped by Johnson et al. (1999) can be traced on to land at the coast in West Seattle; however, mapping of individual strands much beyond the coast is not yet possible (Booth et al., 2003). Work by Harding et al. (2002) further confirms that at least three of the strands of the Seattle Fault Zone can be identified in the West Seattle coastline based on topographic data and that the frontal strand moved during the ~900 AD event described by Atwater and Moore (1992). Faults are difficult to map in the Puget Lowland because of dense vegetation, water, coverage by surficial deposits and/or fill, and extensive regrading for urban development in many areas.

Recent work by Sherrod (2005), Sherrod et al. (2001), and Nelson et al. (2003) indicate that known active strands of the Seattle Fault in Bellevue and on Bainbridge Island have produced surface rupture, and some strands have been reactivated by multiple earthquake events. Ten Brink et al. (2006) concluded that the surface rupture that occurred 1100 years ago on at least two strands on the Seattle Fault resulted from a moment magnitude (M) 7.5 earthquake.

The estimated probabilities of an earthquake with $M \geq 6.5$ occurring on the Seattle Fault Zone or from a random shallow crustal source in the Puget Sound region are approximately 5 percent in 50 years (recurrence interval of 1000 years) and 15 percent in 50 years, respectively (EERI, 2005b). These probability estimates have large uncertainties (Frankel, 2007). The probability estimate for an $M \geq 6.5$ earthquake on the Seattle Fault Zone is based on trenching studies at a small number of locations as well as a slip rate estimate that has a large uncertainty (Frankel, 2007). The probability estimate of a random shallow earthquake with $M \geq 6.5$ in the Puget Sound region is based on extrapolating the rate of observed earthquakes with magnitudes of 4 and above (Frankel, 2007).

Table 1: Recent references on geometry and structure of the Seattle Fault Zone

Factor	Finding	Source
Seattle Fault Zone geometry	Fault Zone delineated based upon Blakely et al. (2002), Brocher et al. (2004), subsurface stratigraphy, and geologic mapping	Troost, et al., 2005
	Seismic reflection, aeromagnetic, gravity, and geologic data used to interpret the Seattle Fault Zone as a passive-roof duplex associated with the Tacoma Fault Zone. The overlying shallow roof thrust is passive and only slips when the underlying Seattle Fault or Tacoma Fault ruptures. The master floor thrust is the most important thrust beneath Seattle.	Brocher, et al., 2004
	Paper focused on the Tacoma fault. Crustal deformation between Seattle and Tacoma is forced by slip on the deeper Seattle fault. Motion is distributed on the shallow Seattle Fault Zone, Tacoma fault, East Passage Fault Zone and other structures beneath the Seattle uplift.	Johnson et al., 2004
	Shallow velocity structure of the Seattle Fault Zone imaged by tomographic inversion of a very dense data set of seismic reflection profiles shot during the 1998 SHIPS experiments (seismic reflection studies). Along-strike differences in the uplift of Tertiary rocks beneath Puget Sound are likely attributable to the existence of a segment boundary in the Seattle fault system. Segmentation, if present, did not prevent two strands from rupturing across the boundary during the ~AD 900 event.	Calvert et al., 2003
	Used the results of a high-resolution aeromagnetic survey to define four main strands of the Fault Zone over an east-west distance of >50km. These strands coincide with the large gravity anomaly, geologic data, and seismic reflection data presented by previous studies. The magnetic anomalies coincide with steeply dipping bedrock in the hanging wall of the Seattle Fault Zone.	Blakely et al., 2002
	Results from 1998 SHIPS seismic reflection studies confirms newly proposed location for the Seattle Fault Zone in Blakely et al., 2002. Seattle Fault Zone produces a prominent velocity anomaly.	Brocher et al., 2001

	Analyzed high-resolution and conventional industry marine seismic reflection data to characterize the Fault Zone as a 4 to 6 km wide (north-south direction) zone consisting of three or four east-west trending fault strands. Also identified north-trending high-angle strike slip fault zone in Puget Sound that cuts the Seattle Fault Zone into segments.	Johnson et al., 1999
	Used industry seismic reflection data in an initial attempt to define the deep geometry of faults in the Puget Lowland area. Based on this model, most of the faults and folds in the region are related at depth and are components of a north moving thrust sheet. The Seattle fault is interpreted to be a thrust fault dipping southward at an angle of about 20 degrees but steepening to 45 degrees in the near surface. Data indicate >7 km of throw across the fault over the last 40 million years.	Pratt et al., 1997
Known strands of the Seattle Fault	Five trenches across a Holocene fault scarp on Bainbridge Island yield the first radiocarbon-measured earthquake recurrence intervals for a crustal fault in western Washington. The scarp, the first to be revealed by laser (LIDAR) imagery, marks the Toe Jam Hill Fault, a north-dipping backthrust to the Seattle fault. Folded and faulted strata, liquefaction features, and forest soil A horizons buried by hanging-wall-collapse colluvium record three, or possibly four, earthquakes between 2500 and 1000 yr ago. The most recent earthquake is probably the 1050-1020 yr B.P. (A.D. 900-930) earthquake that raised marine terraces and triggered a tsunami in Puget Sound. Vertical deformation estimated from stratigraphic and surface offsets at trench sites suggests late Holocene earthquake magnitudes near M7, corresponding to surface ruptures > 36 km long. Corresponding fault-slip rates are 0.2 mm/yr for the past 16,000 yr and 2 mm/yr for the past 2500 yr. Because the Toe Jam Hill fault is a backthrust to the Seattle fault, it may not have ruptured during every earthquake on the Seattle fault.	Nelson et al., 2003
	At Vasa Park on the west shore of Lake Sammamish, trenching exposed a fault zone. The fault moved at least one time at the very beginning of the Holocene. Only one, limiting, maximum age was obtained.	Sherrod et al., 2001

	Topographic analyses of uplifted marine platforms based on Lidar mapping suggest that activity on the strands of the Seattle fault in West Seattle date to or after the ~900 AD event.	Harding et al., 2002
	Excavation at Vasa Park in Bellevue showed the south side of the fault pushing up and to the north by about 6-1/2 feet during the very beginning of the Holocene. Finding is important because the trench shows that earthquakes on the Seattle fault have occurred on both sides of Puget Sound, provides clear evidence for an earthquake unrelated to the one 1100 years ago, is different from the north side up motions on faults west of Puget Sound.	EERI, 2005a
	Provides a summary of active fault zones in the Puget Lowland. Lidar scarps in the Seattle Fault Zone are north-side-up, opposite the vergence suggested for the Seattle fault. Trenching data reveal as many as three surface rupturing earthquakes in the past 2500 years.	Sherrod, 2005
	Stratigraphic and geomorphic evidence supports that strands of the Seattle fault as mapped by Johnson et al., 1999, can be traced onto land at the coast in West Seattle. Mapping of individual strands much beyond the coast is not yet possible.	Booth et al., 2003

Designation of the Seattle Fault Zone

Mapping by Troost et al. (2005) represents the most current delineation of the area of suspected fault rupture hazard. The Seattle Fault Zone shown in this reference considers the fault models postulated by Blakely et al. (2002) and Brocher et al. (2004), constrained and modified by areas of geologic evidence such as uplifted beach deposits, down-dropped tidal marshes, offset strata, and deformation such as sheared and tightly folded strata near the northern edge of the Fault Zone. Troost et al. (2005) designate the Seattle Fault Zone as a zone, rather than specific lines, because of the uncertainty in the postulated fault models and the uncertainty in precise locations of fault strands; however, all of the postulated models present four or more possible east-west trending strands or a large area over which deformation could possibly occur due to movement on deeper portions of the Seattle Fault. Surface rupture is possible along existing strands within the Seattle Fault Zone and less likely along new faults within the Seattle Fault Zone (Troost, 2007).

It is likely that the State of Washington in conjunction with the U.S. Geological Survey will issue a map of active faults in the State of Washington some time in 2007 (Troost, 2007 and Walsh, 2007).

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Tsunami Inundation Areas

Background

A tsunami is a series of water waves of extremely long period and long wavelength (distance from crest to crest) caused by a sudden disturbance that vertically displaces the water. Sudden offsets in the earth's crust, such as during earthquakes, can cause a tsunami. Landslides and underwater volcanic eruptions can also generate tsunamis.

Washington's outer coast is vulnerable to tsunamis from distant sources (such as earthquakes in Alaska, Japan, or Chile) and from the adjacent Cascadia Subduction Zone (CSZ). The CSZ is a fault located at the boundary between two tectonic plates, and it has generated earthquakes of magnitude 8 or larger at least six times in the past 3,500 years. Computer modeling by Walsh et al. (2000) indicates that a tsunami due to a great earthquake on the CSZ could cause a tsunami up to 30 feet in height that would affect the entire Washington coast.

Washington's inland waters, such as those in the Puget Sound region, are also subject to tsunamis, particularly those generated by local crustal earthquakes or by surface and submarine landslides. Atwater and Moore (1992) showed that a magnitude 7+ earthquake approximately 1100 years ago on the Seattle Fault Zone likely created a tsunami in Puget Sound that deposited sand at West Point and Cultus Bay near Whidbey Island. Karlin et al. (2004) present evidence of earthquake-induced submarine slope failures interspersed throughout Lake Washington that would likely have produced associated tsunamis or seiches. Lander et al. (1993) reported an eight foot wave in Lake Washington resulting from landslides caused by the 1891 Port Angeles Earthquake. Landslide-induced tsunamis in the Puget Sound include the early 1800's Camano Head Tsunami, 1890's Puget Island Tsunami near Cathlamet, 1891 Puget Sound Tsunami, 1894 Commencement Bay Tsunami, and 1949 Puget Sound Tsunami at Point Defiance (Washington State Hazard Mitigation Plan, 2004).

Effects of Tsunami Inundation

Tsunamis typically cause the most severe damage near their source, where the waves are highest because they have not yet lost much energy to friction or spreading. Nearby populations, often disoriented from the earthquake shaking, have little time to react before the tsunami arrives, and persons caught in the tsunami may be crushed by debris or drown.

In the deep ocean, a tsunami is barely noticeable as a small rising and falling of the ocean surface. When the tsunami approaches land and shallow water, the waves slow down, become compressed, and increase in height. A tsunami can come on shore quickly like a rising tide and flood low-lying areas, or it can rush onshore as a wall of turbulent water with great destructive power. Minutes later, the water will drain away as the trough of the tsunami arrives. This destructive cycle may repeat many times before the tsunami dissipates.

The amount of destruction to structures and other facilities depends on wave period, wave height, and wave and current velocities. Tsunamis can cause structural failure, scouring at foundations, erosion, flooding, battering, movement of sediment and objects, and loss of life.

Recent Studies of Tsunami Inundation in the Puget Sound

The City of Seattle may be subject to tsunamis from the following sources: (1) shallow crustal earthquakes that rupture the submarine floor of Puget Sound, (2) shallow crustal earthquakes that rupture the floor of Lake Washington, (3) landslides within or into Puget Sound, (4) landslides within or into Lake Washington, and (5) lateral spreading due to liquefaction producing landslides into or in the Duwamish River and/or Puget Sound. At this time, no marine inundation is expected in the Seattle area from tsunamis generated from subduction zone earthquakes because the waves that deflect around the 90-degree bend to enter central Puget Sound would be small and attenuated by the time they reached the City of Seattle (Walsh, 2007; Murty and Hebenstreit, 1989).

As part of the Tsunami Inundation Modeling Efforts (TIME) within the National Tsunami Hazard Mitigation Program, Titov et al. (2003) have developed a high resolution computer model to estimate potential tsunami inundation along the shores of Seattle. The model is based upon a tsunami generated by a magnitude 7.3 event on the Seattle Fault Zone. The displacements along the Seattle Fault Zone are based upon those reported by Bucknam et al. (1992) from a magnitude 7+ earthquake that occurred approximately 1100 years ago. Walsh et al. (2003) used the results of the modeling by Titov et al. (2003) to produce the most recent tsunami inundation map of the Elliott Bay area. Other tsunami modeling studies (e.g. Koshimura et al., 2002) for tsunamis generated by historical movement on the Seattle Fault Zone have also been performed as part of the National Tsunami Hazard Mitigation Program; however, these studies were done at lower resolution.

At present, no modeling studies of tsunamis in Lake Washington generated by fault rupture in the lake or by landsliding have been performed. Karlin et al. (2004) present evidence of numerous submarine landslides in Lake Washington that were probably caused by earthquakes, but wave heights of any tsunamis generated by these events were not estimated.

Kayen et al. (1999) describe extremely young and thick deposits of sand at the Duwamish delta front, rapidly deposited by geologic processes, which have formed loose deposits that are highly susceptible to liquefaction under expected levels of seismic loading (e.g. from the Seattle Fault Zone, other shallow crustal faults, or the CSZ). Liquefaction-induced lateral spreads or flow slides at the Duwamish delta front along the northern end of Harbor Island could result in a tsunami (Troost, 2007). No modeling of this scenario is currently available, and we do not have evidence of previous occurrences; however, liquefaction-induced landslides have occurred in other areas resulting in water waves. For example, a submarine landslide in the Puyallup delta at Commencement Bay in 1894 (likely the result of static liquefaction) resulted in a 3 to 4.5 meter (9.8 to 14.8 ft) high water wave (Palmer, 2005). It is unlikely that such an event would impact areas outside of those currently delineated in the Walsh et al. (2003) tsunami hazard map (Troost 2007).

A summary of findings from the most significant reviewed references is presented in Table 2.

Table 2: Recent tsunami studies for the Seattle area

Factor	Finding	Source
Tsunami inundation studies for Seattle Fault Zone earthquake	Tsunami inundation map based upon the modeling by Titov et al., 2003 for rupture on the Seattle Fault Zone.	Walsh et al., 2003
	Finite-difference, high resolution computer model used to develop map of potential tsunami inundation along the Puget Sound shores of Seattle Washington. Assumed magnitude 7.3 earthquake on the Seattle Fault with displacements consistent with that reported by Bucknam et al., 1992 from a magnitude 7+ event on the Seattle Fault 1100 years ago (7 m uplift at Restoration Point, 4m uplift at Alki Point, and over 1 meter of subsidence at West Point). Manning coefficient of n=0.025 (mildly rough surface) used for bottom friction in inundation model does not consider buildings and other structures. Vertical datum of Mean High Water was used. Maximum amplitudes of tsunamis approaching shores of Elliott Bay fluctuate around 6 meters. Maximum vertical runup of 10 meters is calculated southwest of Magnolia Bluff. The model shows isolated areas of maximum current speeds that impact land of up to 30 meters/second; however, most of the modeled current speeds range from about 1.5 meters/ second to 10 to 15 meters/second as the waves impact the land. The model shows the first wave crest reaching southwest of Magnolia Bluff 2 minutes 20 seconds after generation. Within half a minute after that, this wave crest reaches all the shores around Elliott Bay. The south shores of Elliott Bay are inundated when a large wave reflected from the northern coasts reaches Harbor Island about 5 minutes after the earthquake.	Titov et al., 2003

	Finite-difference computer model (30 to 90 meter grid spacing) used to model the magnitude 7+ event on the Seattle Fault approximately 1100 years ago. Modeled displacements consistent with Bucknam et al., 1992. Tsunami inundation zone presented for the Cultus Bay area. Tsunami more than 3 meters high strikes the Seattle waterfront.	Koshimura, S., et al., 2002
	Finite-difference low resolution computer model used to develop potential tsunami inundation map for the Seattle waterfront. Assumed magnitude 7.2 on the Seattle Fault deformation of 2.3 meters of maximum uplift at the sea bottom between Bainbridge Island and Elliott Bay. Model grid size is 30 to 90 meters. Inundation of 2 meters at Pier 90/91 and greater than 1 meter at Pier 36 to 77.	Koshimura, S and Mofjeld, H., 2001
Tsunami inundation depth for Cascadia Subduction Zone (CSZ) earthquake	Finite-element model used to develop potential tsunami inundation map for the southern Washington Coast. Assumed earthquake is a magnitude 9.1 CSZ event with a rupture length of 1050 km and rupture width of 70 km. Land surface along the coast was modeled to subside by about 1 to 1.5 meters, consistent with some paleoseismic investigations. One model includes an area of locally greater fault slip along the fault plane; the second model does not. This is the same model adopted for tsunami inundation mapping in Oregon as well. Map only shows inundation for the Washington Coast. A movie file of the tsunami model shows wave heights of up to about 1 meter along the coast of Seattle; however, the model was not set up as an inundation model for Seattle.	Walsh et al., 2000
	No marine inundation is expected in the Seattle area from tsunamis generated from subduction zone earthquakes. Tsunami waves would be expected in Bellingham Bay or the west side of Whidbey Island.	Walsh, 2007
	Tsunami waves from CSZ that deflect around the 90-degree bend into Puget Sound from the Strait of Juan de Fuca will be small and attenuated by the time they reach Seattle. Study does not include inundation modeling for Seattle.	Murty and Hebenstreit, 1989

Tsunamis due to landslides in Lake Washington	Numerous submarine landslides (large block slides, sediment slumps and debris flows) are present throughout the lake, and are attributed to large earthquakes that have occurred in the Puget Sound region about every 300 to 500 years. Benioff zone (e.g. 1949, 1965, or 2001 Nisqually) earthquakes have not caused large block slides in Lake Washington, so it is clear that the prehistoric earthquakes that triggered these slides had stronger ground motion than any earthquakes this century.	Karlin et al., 2004
	Reported an eight foot wave in Lake Washington resulting from landslides caused by the 1891 Port Angeles Earthquake.	Lander et al., 1993
Tsunamis in Puget Sound due to fault rupture	Large earthquake on the Seattle Fault approximately 1000 to 1100 years ago probably generated a tsunami by causing abrupt uplift south of the fault and complementary subsidence to the north. This movement would have caused water in Puget Sound to surge northward. Found tsunami sand deposits at West Point and Cultus Bay near Whidbey Island.	Atwater and Moore (1992)
Tsunamis in the Duwamish River or Puget Sound due to liquefaction/lateral spreading	At the Duwamish River delta, extremely young and thick deposits of sand that were rapidly deposited by geologic processes have formed a loose deposit that is highly susceptible to liquefaction. Under expected levels of seismic loading, the analysis indicates that a large-strain flow failure may occur at the delta front along the northern end of Harbor Island.	Kayen et al., 1999
	Documented evidence of a submarine landslide occurring on the Puyallup delta at Commencement Bay in 1894 that resulted in a 3 to 4.5 m high water wave that was likely the result of static liquefaction.	Palmer, 2005

Extent of Tsunami Hazard Areas

Mapping by Walsh et al. (2003) represents the most current delineation of the area of suspected tsunami hazard along Seattle's marine shorelines. Although this map only considers a tsunami that may be generated by a major earthquake on the Seattle Fault Zone, this event is likely to be more severe than other potential tsunamis caused by local landslides or lateral spreading/flow slides into the Duwamish River. Hazard areas for tsunamis from these other sources are likely to be contained within the delineation by Walsh et al. (2003). Thus, this map represents a reasonable boundary for suspected tsunami risks on Seattle's marine shorelines (Troost, 2007).

There is no available scientific evidence or studies that suggest a risk from tsunamis in Lake Union. Tsunamis are known to occur in Lake Washington, however no scientific studies in any way characterize the extent of this potential hazard. Accordingly, the extent of tsunami hazards surrounding Lake Washington is currently unknown. There are no performance standards presented in the literature to determine tsunami risk on a site by site basis.

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Seiches

Background

Seiches are a series of standing waves contained in an enclosed or partially enclosed body of water and are analogous to the sloshing of water that occurs when a bowl of water is moved back and forth. Seiches can occur in harbors, bays, lakes, rivers, and canals. Locally, Lake Union, Lake Washington, and, to a lesser extent, Elliott Bay hold significant potential for seiche activity.

Seiches are caused commonly by wind, water waves, or tides, but present the greatest threat to public safety when initiated as a result of a tsunami or earthquake. Tsunami-induced seiches represent the continuing oscillation of a waterbody that occurs after the initial originating force of the tsunami. Earthquake-induced seiches occur as the result of low frequency seismic waves that rhythmically oscillate the entire basin of the waterbody. Earthquake-induced seiches frequently occur as a result of distant earthquakes rather than local ones as the frequency of vibration produced by an earthquake decreases with distance from the epicenter and the low frequency vibrations associated with distant earthquakes have the greatest impact on bodies of water (King County, 2005). Earthquake-induced seiches are nearly impossible to predict due to the multiplicity of potential sources and lack of earthquake predicting technology. Their onset can be very rapid, and emergency response may be difficult because they occur coincident with other earthquake impacts.

The potential magnitude of a seiche event occurring from any earthquake is difficult to predict as they depend on the magnitude of the earthquake, frequency of vibrations, natural period of the water body, sediment thicknesses, presence of thrust faults and other geologic factors (Barberopoulou, 2006). The biggest seiches develop when the period of ground movement matches the frequency of oscillation in the body of water. Additionally, constructive interference of the seiche waves with water waves can lead to additional wave action.

The sedimentary basins of the Puget Lowland have been documented to affect the amplitude of seismic waves at long periods, generally increasing the potential for seiche events (Pratt et al., 2003; Barberopoulou, 2004). Lake Union, in particular, has been observed to be prone to earthquake-induced water waves due to its relatively small size and its location in the Seattle basin (Barberopoulou, 2004). Modeling by Barberopoulou (2006) further indicates that Lake Union is particularly prone to wave action in the east-west direction of the main body due to the parallel nature of the east and west shorelines as well as wave action in the northern arms due to the small width of these channels and the redirection of north-south waves by the v-shaped extrusion around Gas Works Park.

Effects of Seiches

Seiches can cause significant impacts due to rapidly changing water levels, particularly along the shoreline where the rhythmic "sloshing" motion can cause damage to moored boats, utilities, piers and facilities close to the water. Common damages resulting from seiches include broken piers, ruptured house boat connections, damaged or disconnected boats, and flooding. The high prevalence of houseboats along Lake Union may make this area particularly prone to damage.

The Lake Washington floating bridges may also be at risk for seiche damage; the bridges have withstood standing waves up to eight feet in height (King County, 2005). A seiche's rapid onset could also prevent motorists from exiting the bridge before a hazardous situation occurs.

There is also the potential for seiches to cause landslides by eroding the base where landslide-prone bluff areas abut the water.

Historic records of Seiches

Seiches occur infrequently in the Puget Sound, but have been observed to accompany many of the high magnitude earthquakes in the recent history of the Pacific Northwest and Alaska. A brief history of recent seiche activity around Seattle is presented below:

Table 3: Historic records of Seiches

Date	Description
1949	Both Lake Union and Lake Washington experienced seiches during the 7.1M Queen Charlotte Island earthquake, but no damage was reported.
1964	Seiches in Lake Union damaged houseboats, buckled moorings, and broke water and sewer lines as a result of 9.2M Alaska earthquake. Damage was estimated at $5,000 (Wilson and Torum, 1972). Additionally, a seiche of 0.4 ft (0.12 m) crest to trough lasting 48 minutes was measured at a tide station in Puget Sound (McGarr and Vorhis, 1968).
1965	During the 6.5M Seattle earthquake, seiches were reported in Lake Washington and Lake Union, but no significant damage was observed.
2002	Seiches damaged houseboats, buckled moorings, and broke water and sewer lines in Lake Union following the 7.9M Alaskan earthquake. Damage was limited to about 20 houseboats. While no historic records are available to document the size of waves produced during this event, modeling by Barberopoulou (2006) predicted maximum wave heights of 1.41 ft (0.43 m) as a result of this event.

Little historic data exists as to the height, duration or inland extent of waves generated as a result of these events. Historical data is limited to anecdotal reports collected by local newspapers and the USGS as well as the single recording at a tide station in 1964. None of this data addresses the inland extent of waves generated by a seiche.

Seiche Studies in Seattle

A summary of findings from the most significant reviewed references is presented in Table 4.

Table 4: Recent tsunami studies for the Seattle area

Report	Findings
Barberopoulou, 2006	Modeled the seiche activity that is likely to occur as a result of four potential earthquake scenarios. This exercise demonstrated that Lake Union is particularly prone to wave action in the east-west direction of the main body due to the parallel nature of the east and west shorelines as well as wave action in the northern arms due to the small width of these channels and the redirection of north-south waves by the v-shaped extrusion around gas works park. This study also noted the relative potential for different earthquake types to produce seiche activity in Lake Union. Deep Benioff zone earthquakes (e.g. 2001 Nisqually) and earthquakes caused by the Seattle Fault do not seem to have the capability to produce large oscillations in Lake Union. A model based on the 2001 Nisqually earthquake produced maximum water wave heights of 0.46 ft (0.14 m). Instead, Lake Union was found to be particularly prone to earthquakes occurring at extra-regional distances such as the Denali Fault in Alaska or the San Andreas in California. A model of the 2002 Denali earthquake produced maximum wave heights of 1.41 ft (0.43 m) in Lake Union. A model of a subduction zone earthquake was found to have the most dramatic effect in Lake Union with predicted water waves reaching 3.9 ft (1.2 m). The model did not look at impacts to the shoreline or inundation from a seiche event.
Barberopoulou et al., 2004	Documented damage to 20 houseboats in Lake Union from seiche activity resulting from the 2002 Denali earthquake. Their analysis of this event showed substantially increased shear and surface wave amplitudes coincident with the Seattle sedimentary basin, indicating that size of the water waves may have been increased by local amplification of the seismic waves by the basin.
Karlin et al., 1992	Found evidence that suggests a number of simultaneous landslides occurred in Lake Washington about 1100 years ago that correlate with other indications of earthquake activity from other parts of the state.
Karlin et al., 2004	Numerous submarine landslides (large block slides, sediment slumps and debris flows) are present throughout the lake, and are attributed to large earthquakes that have occurred in the Puget Sound region about every 300 to 500 years. Benioff zone (e.g. 1949, 1965, or 2001 Nisqually) earthquakes have not caused large

	block slides in Lake Washington, so it is clear that the prehistoric earthquakes that triggered these slides had stronger ground motion than any earthquakes this century.
McGarr and Vorhis, 1968	Documented seismic seiches occurring throughout the United States as a result of the 1964 Alaskan earthquake. Documented a seiche of 0.4 ft (0.12 m) crest to trough lasting 48 minutes occurring in Puget Sound as a result the 1964 Alaskan earthquake.
Pratt et al., 2003	Presented evidence that the Seattle Basin causes local amplification of seismic waves based on records of past earthquakes
Wilson and Torum, 1972	Noted occurrence of seiche in Lake Union resulting in $5,000 of damage to several pleasure crafts, houseboats, floats that broke their mooring due to 1964 Alaskan earthquake. No damage to shorelines was noted.

Extent of Seiche Hazards Risk

Historical records and scientific studies document a known hazard from seiche activity within the waters of Lake Union, Lake Washington, and the Puget Sound. Documentation of seiches in 1949, 1964, 1965 and 2002 clearly identifies a seiche hazard that exists within the submerged portions of these waterbodies; however, the potential hazard that these events pose to adjacent shorelines is unknown.

Historical records do not document any damage to Seattle shorelines due to seiche activity, although the 1964 Alaska earthquake produced a seiche in the reservoir at Aberdeen that caused an embankment failure so impacts are clearly possible (Troost, 2007). Scientific studies on this subject also remain insufficient to characterize the potential impact of seiche activity on shorelines as they lack any analysis of land inundation. However, since seiches are standing waves rather than moving water flows, potential inundation of the surrounding shorelines is considered to be a minimal risk.

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Lahar Hazard Zones

Background

A lahar is a gravity-driven mixture of sediment and water that originates from the flanks of a volcano. Such flows are analogous to debris flows, but typically are very large in size due to the high elevations, steep slopes, and abundance of loose or hydrothermally weakened material associated with volcanoes. Lahars can initiate as a result of; (1) melting of snow and ice by radiant heat or pyroclastic flows generated during an eruption, (2) collapse of the steep sides of a volcano, (3) heavy rainfall eroding volcanic deposits, (4) seismically induced landslides, (5) magmatic intrusion or (6) floods generated by lake or glacial outburst. Lahars not associated with volcanic eruption pose a particular problem because they can occur spontaneously without any of the warning signs accompanying an eruption such as increased tremor activity.

Lahars can vary in character with time and distance from their source. Lahars generally flow in one of three types of phases: debris-flow phase, transitional or hyperconcentrated-flow phase and stream-flow phase. In the debris-flow phase, the solid and liquid fractions of the lahar are in roughly equal volume and are mixed through the vertical section. Due to the mix of water and debris, lahars in this phase generally look and behave like flowing concrete. In the stream-flow phase, water transports fine-grained sediment in suspension and coarse-grained sediment along the bed at discrete intervals. Transitional flow occurs between these stages as a lahar carries higher sediment loads than stream-flow, but vertical sorting differentiates it from debris-flow (Vallance, 2000).

Lahars represent a significant hazard for communities located downstream of volcanoes because of their ability to travel long distances quickly, transport large debris such as logs and boulders, and bury floodplains under tens of feet of sediment. They can travel tens of miles at speeds of tens to hundreds of miles per hour, although energy generally decreases with distance from the source. The pathway of a lahar is defined by the topography, generally following river channels and other depressions.

Mount Rainier represents the only active volcano that may pose a hazard to the City of Seattle from lahar activity. Three river networks (White, Carbon, and Puyallup) provide potential pathways for lahar activity from Rainier, which could connect with the Duwamish River valley and impact areas of Seattle (Hoblitt et al., 1998). Mount Rainier readily generates lahars. It has a large volume of snow and glacier ice (more than the combined volume of glacier ice on the other Cascade volcanoes) available for melting during an eruption and a large volume of hydrothermally altered rock. It also stores water beneath its glaciers, which is sometimes released as outburst floods.

Four classes of lahars are defined in Hoblitt et al. (1998). In order of decreasing size and increasing frequency, these are called Case M, Case I, Case II, and Case III lahars.

Case M: Case M flows are low-probability, high-consequence lahars, such as the largest lahar to occur at Mount Rainier in the past 10,000 years. These lahars are associated with volcanic activity and sometimes collapse of portions of the volcano. The Washington State Hazard Mitigation Plan (2004) reports that flows of Case M magnitude occur far less frequently than once every 1000 years.

Case I: Case I flows are smaller than Case M flows, and they generally originate from debris avalanches of hydrothermally altered rock. Case I flows are not necessarily associated with volcanic eruptions. They occur about once every 500 to 1000 years.

Case II: Case II flows have relatively low clay content and the most common origin for this type of flow is the melting of snow and glacier ice by hot rock fragments during a volcanic eruption. However, Case II flows can also be triggered by heavy rains or other non-eruptive origins. Case II flows have recurrence intervals on the lower end of the 100- to 500-year range.

Case III: Case III flows are relatively small but have recurrence intervals of 1 to 100 years. These types of flows are not triggered by volcanic eruptions. On Mount Rainier, they rarely move beyond the National Park boundary.

Historic Records of Lahars on Mount Rainier

The Mount Rainier volcano has produced 60 lahars of various sizes and numerous large lahars during the past 10,000 years that flowed down the White River as far as the site of the cities of Auburn and Kent. The most well-documented such flow is the Osceola Mudflow, which left deposits nearly as far north as the city of Renton approximately 5,700 years ago (Dragovich et al., 1994; Vallance and Scott, 1997). The Osceola Mudflow was at least 10 times larger than any other known lahar from Mount Rainier. Deposits from this event are estimated at 0.89 mi^3 and covered an area of about 200 square miles in the Puget Sound lowlands (Hoblitt et al., 1998; Dragovich et al., 1994). Flows of the size of the Osceola Mudflow are termed Case M flows by Hoblitt et al. (1998).

Lahars that have occurred since the Osceola Mudflow played an important role in shaping the landscape in the Duwamish Valley. At the time of the Osceola Mudflow, the Duwamish Valley between Auburn and Seattle existed as an arm of Puget Sound. The Osceola Mudflow contributed to filling of that arm between Renton and Auburn. Since the Osceola Mudflow, at least four lahars from Mount Rainier either reached the Duwamish Valley or transported sediment that was then rapidly reworked and redeposited by post-lahar floods (Zehfuss, et al., 2003 and Zehfuss, 2005). As a result, a layer of lahar-derived sand and silt from post-Osceola events underlies much of the floor of the Duwamish Valley at Seattle to depths of up to 60 feet (Troost, 2007).

Other significant recent Mount Rainier lahars include:

- The Electron Mudflow which occurred about 600 years ago and produced an estimated 300 million cubic yards of debris. This event is considered to be characteristic of Case I lahars which have occurred on average about once every 500 to 1000 years during the last 5,600 years.

- In 1947 in Kautz Creek, at least four lahars were triggered by heavy rain and release of water stored within a glacier. These events deposited a total of about 50 million cubic yards of debris, though each individual flow of the 1947 sequence probably did not exceed 21 million cubic yards. The 1947 sequence of lahars is considered to be the most recent example of Case II lahars. For planning purposes, Case II flows are analogous to the 100-year flood commonly considered in engineering practice. The National Lahar, which occurred less than two thousand years ago and inundated the Nisqually River valley, is considered by Hoblitt et al. (1998) as a characteristic Case II flow for the purposes of identifying inundation areas.

Effects of Lahars

The direct flow of a lahar contains tremendous energy that can easily destroy buildings and almost anything it its path. Buildings and valuable land may become partially or completely buried by the layers of debris. Lahars can also trap people in areas vulnerable to other volcanic hazards by destroying bridges and key roads or burying them in often hot and unstable debris.

Due to its significant distance from Mount Rainier and the long recurrence interval for Case M lahars, however, the City of Seattle is more likely to experience the impacts of post-lahar sedimentation than direct flow (Hoblitt et al., 1998). Post-lahar sedimentation can occur well beyond the direct pathway of a lahar as the water and sediment released by a lahar fill up river channels, reroute water courses, and raise river levels. Other secondary effects of a lahar include loss of storage at dams, destruction of existing dams or the creation of temporary sediment dams. These effects result in significant damage to infrastructure, but may also lead to additional flood events as dams burst or are unable to hold secondary flooding activities (Hoblitt et al., 1998).

The distance between Mount Rainier and the City of Seattle also creates a considerable delay between the formation of a lahar and its arrival in Seattle. A lahar originating in the Sunset Amphitheater at the top of the Puyallup Glacier is projected to reach Auburn about 96 minutes after the lahar warning system sounds an alarm and the warning time to Seattle would be even longer (Washington State Hazard Mitigation Plan, 2004). This time delay would give citizens time to evacuate the area provided that warning systems are in place.

Extent of Lahar Hazard Areas

Hoblitt et al. (1998) maps an inundation zone for Case M lahars that reaches Harbor Island and surrounding areas via the Duwamish River.

Hoblitt et al. (1998) also maps potential areas at risk from Case I and Case II lahars. The City of Seattle is at significantly reduced risk of inundation from Case I lahars, and post-lahar sedimentation is more probable. The Green River valley and the Duwamish River valley (including the City of Seattle) could be at significant risk to a Case II lahar and post-lahar sedimentation if one of two conditions occurs:

(1) The available storage of Mud Mountain Reservoir is reduced significantly by a lahar or post-lahar sedimentation.
(2) The profile of the lower White River valley south of Auburn is changed sufficiently by a lahar or post-lahar sedimentation to cause the White and Puyallup Rivers to drain northward into the Green and Duwamish River valleys.

Without one of these conditions, the City of Seattle's risk from Case II lahars is primarily from post-lahar sedimentation.

The maps by Hoblitt et al (1998) represent the most current delineation of areas of potential lahar inundation and post-lahar sedimentation hazard.

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Miles Mayhew/MM
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FISCAL NOTE FOR NON-CAPITAL PROJECTS

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Legislation Title:
An ordinance relating to environmentally critical areas, amending Seattle Municipal Code Sections 25.09.015 25.09.020, and 25.09.030 to address the findings of the Central Puget Sound Growth Management Hearings Board.

- **Summary of the Legislation:**

The Department of Planning and Development (DPD) proposes to amend the geologic hazard designations of the Environmentally Critical Areas (ECA) regulations.

- **Background:**

The proposed Council Bill addresses the issues raised in the Final Order and Decision of the Central Puget Sound Growth Management Hearings Board in the appeal of the City's new ECA ordinance (CPSGMHB Case No. 06-3-0024 Seattle Audubon Society, Yes for Seattle, Heron Habitat Helpers and Eugene D. Hoglund v City of Seattle). The order and decision requires Seattle to designate the Seattle Fault, tsunami, and seiche and lahar inundation areas as geologic hazard areas.

The proposal is based on a review of the best available science for geologic hazard areas in Seattle. Key recommendations are to designate as geologic hazards the Seattle Fault Zone, areas at risk from tsunamis in Seattle's marine waters and Lake Washington, areas at risk from lahars in the Duwamish River, and areas at risk from seiches in Seattle's major waterbodies. Further regulation of properties or development in these areas is not proposed.

- *Please check one of the following:*

__X__ This legislation does not have any financial implications.

Attachment A: Director's Report and Recommendation- Amendments to the Geologic Hazard Areas Designations of the Environmentally Critical Areas Regulations

Director's Report and Recommendation

AMENDMENTS TO THE GEOLOGIC HAZARD AREAS DESIGNATIONS OF THE ENVIRONMENTALLY CRITICAL AREAS REGULATIONS

January, 2007

I. Introduction

The Department of Planning and Development (DPD) proposes to amend the geologic hazard designations of the Environmentally Critical Areas (ECA) regulations. This legislation addresses the issues raised in the Final Order and Decision of the Central Puget Sound Growth Management Hearings Board (GMHB) in the recent appeal of the new ECA ordinance (CPSGMHB Case No. 06-3-0024 Seattle Audubon Society, Yes for Seattle, Heron Habitat Helpers and Eugene D. Hoglund v City of Seattle). The order and decision requires Seattle to designate the Seattle Fault Zone, tsunami and seiche inundation areas and lahar inundation areas as geologic hazard areas.

II. Existing Conditions

Currently the ECA ordinance designates landslide-prone areas, steep slopes, and liquefaction-prone areas as geologically hazardous areas. Information on and analysis of the risks associated with these geologic hazard areas can be found in the ECA Ordinance (number 122050) Best Available Science Review (August 2005) and in the ECA Ordinance Director's Report and Recommendation (August 2005).

III. Analysis of the Proposal

The GMHB decision specifically cited the Seattle Fault Zone, tsunami and seiche inundation areas and lahar inundation areas as geologic hazard areas that Seattle must designate in the ECA ordinance. The following summarizes the findings of the Supplemental Best Available Science Report for Geologic Hazard Areas (Exhibit A) and recommends how best to incorporate the scientific findings into the ECA ordinance. The last subsection summarizes some of the on-going emergency management planning and implementation actions that are mitigating the risk from these hazards.

Seattle Fault Zone

A fault is a fracture in the crust of the earth along which rocks on one side have moved relative to those on the other side. Not all earthquakes result in surface rupture, and not all surface rupture occurs along pre-existing faults.

Prior to the 1990's, shallow crustal earthquakes had not been attributed to specific faults in the Puget Sound region, and no evidence of Holocene fault rupture (movement in the last 10,000 years) had been observed. In 1992, scientists discovered the first evidence that the Seattle Fault

Zone is active and capable of producing earthquakes that may result in ground surface rupture - a magnitude 7.0 or greater earthquake approximately 1100 years ago resulted in as much as 7 meters of uplift at Restoration Point on Bainbridge Island, over 4 meters of uplift at Alki Point, and 1 to 1.5 meters of subsidence at West Point. The Supplemental Best Available Science Report for Geologic Hazard Areas (Exhibit A) provides a complete summary of the latest scientific information on the Seattle Fault Zone.

The lengthy estimated recurrence interval of a major Seattle Fault earthquake and the inability of current scientific studies to accurately identify the specific location of future fault rupture create a challenge for designating and mapping the Seattle Fault Zone. However, the science shows that there is risk of surface rupture and an increased risk from ground shaking associated with a Seattle Fault event. This risk is currently taken into account through the requirements of the Seattle Building Code with respect to ground movement, and may also do so with respect to faults if specific faults in the Seattle Fault Zone are located. The City has also developed emergency planning and educational measures and programs to decrease the risk. Scientific studies related to the Seattle Fault are ongoing.

Currently there is no performance standard that can be applied on a site by site basis to determine the risk from the Seattle Fault. Trenching is one possible approach, but not practical as there is no map showing the fault strands at a usable scale. Trenching will not necessarily reveal active strands, depending on the amount of non-native material or regrading at the site. The State of Washington, in collaboration with the U.S. Geological Survey, plans to develop a map of active faults in Washington in 2007. This work may lead to more definitive answers for how best to classify the risks from the Seattle Fault.

The best available science review indicates that the Seattle Fault zone represents a known or suspected risk as per WAC 365-190-080(4)(b)(i). As such it is recommended that the Seattle Fault Zone be classified as a geologic hazard area and mapped according to the best available science as presented in Exhibit A. The U.S. Geological Survey is the authoritative research organization regarding seismic hazards and is therefore relied upon as the source for designation and mapping.

Tsunamis

A tsunami is a series of water waves of extremely long period and long wavelength (distance from crest to crest) caused by a sudden disturbance that vertically displaces water. Sudden offsets in the earth's crust, such as during earthquakes, can cause a tsunami. Landslides and underwater volcanic eruptions can also generate tsunamis. Washington's outer coast is vulnerable to tsunamis from distant sources (such as earthquakes in Alaska, Japan, or Chile) and from the adjacent Cascadia Subduction Zone (CSZ). Washington's inland waters, such as those in the Puget Sound region, are also subject to tsunamis, particularly those generated by local crustal earthquakes or by surface and submarine landslides.

Tsunami risks are currently mitigated through emergency management techniques. Considering the high population density in the potential tsunami hazard area, education to a broad spectrum of the Seattle citizenry may be warranted regarding the potential for tsunami hazards.

The Supplemental Best Available Science Report for Geologic Hazard Areas (Exhibit A) provides a complete summary of the latest information on the tsunami risk in Seattle. This review, concludes that the mapping by Walsh et al. (2003) represents the most current delineation of the area of suspected tsunami hazard along Seattle's marine shorelines. Although this map only considers a tsunami that may be generated by a major earthquake on the Seattle Fault Zone, this event is likely to be more severe than other potential tsunamis caused by local landslides or lateral spreading/flow slides into the Duwamish River. Hazard areas for tsunamis from these other sources are likely contained within the Walsh et al. (2003) map. Thus, this map represents a reasonable boundary for suspected tsunami risks on Seattle's marine shorelines. As such, tsunamis represent a known or suspected risk to Seattle's marine shorelines as per WAC 365-190-080(4)(b)(i).

In addition, the science points to a known risk from tsunamis in Lake Washington. However the risk to the shoreline and upland areas surrounding Lake Washington is unknown. In addition, there is no performance standard that can be applied on a site by site basis to determine the risk. Since there is no documented damage, areas adjacent to Lake Washington are recommended to be classified as having an unknown risk as per WAC 365-190-080(4)(b)(iii), as to both the likelihood of risk and its potential distance from the high water mark.

As additional scientific information becomes available it should be reviewed to determine whether these classifications should be adjusted and whether additional measures should be taken. The U.S. Geological Survey, the National Oceanic and Atmospheric Administration and the Washington State Department of Natural Resources are authoritative research organizations regarding tsunamis and are therefore relied upon as the source for designation and mapping.

Seiches
Seiches are a series of standing waves contained in an enclosed or partially enclosed body of water and are analogous to the sloshing of water that occurs when a bowl of water is moved back and forth. Seiches can occur in harbors, bays, lakes, rivers, and canals. Locally, Lake Union, Lake Washington, and to a lesser extent, Elliott Bay hold potential for seiche activity.

Historical records do not document any damage to Seattle shorelines due to seiche activity, although the 1964 Alaska earthquake caused a seiche in the reservoir at Aberdeen, Washington that resulted in an embankment failure. Thus, impacts are clearly possible. Scientific studies on this subject also remain insufficient to characterize the potential impact of seiche activity on shorelines as they lack any analysis of land inundation. Since seiches are standing waves rather than moving water flows, potential inundation on the shore is considered to be a minimal risk.

The Supplemental Best Available Science Report for Geologic Hazard Areas (Exhibit A) provides a complete summary of the latest information on the seiche risk in Seattle. Based on this review, it is recommended that Lake Union, Lake Washington and Elliott Bay be classified as having a known seiche hazard risk as per WAC 365-190-080(4)(b)(i). As there is no documented damage above the high water mark in Seattle, areas adjacent to these waterbodies are recommended to be classified as having an unknown risk as per WAC 365-190-080(4)(b)(iii), as to both the likelihood of risk and its potential distance from the high water mark. In addition, there is no performance standard that can be applied on a site by site basis to determine the risk. Seiche hazards are best addressed though education and emergency management planning. As additional scientific information becomes available it should be reviewed to determine whether these classifications should be adjusted and whether additional areas can be designated for this risk.

Lahars

A lahar is a gravity-driven mixture of sediment and water that originates from the flanks of a volcano. Such flows are analogous to debris flows, but typically are very large in size due to the high elevations, steep slopes, and abundance of loose or hydrothermally weakened material associated with volcanoes. Lahars can initiate as a result of (1) melting of snow and ice by radiant heat or pyroclastic flows generated during an eruption, (2) collapse of the steep sides of a volcano, (3) heavy rainfall eroding volcanic deposits, (4) seismically induced landslides, (5) magmatic intrusion (magma rising to the surface and causing ice to melt) or (6) floods generated by lake or glacial outburst.

According to the best available science review, a Case M lahar could potentially travel to Seattle from Mount Rainier. Case M flows are low-probability, high-consequence lahars, such as the Osceola Mudflow, the largest lahar to occur at Mount Rainier in the past 10,000 years. Case I lahars (recurrence interval of 500 to 1000 years) and Case II lahars (recurrence interval of about 100 years) could lead to post-lahar sedimentation or some lahar deposition in Seattle. The Supplemental Best Available Science Report for Geologic Hazard Areas (Exhibit A) provides a complete summary of the latest information on the risk from lahars in Seattle.

Based on the best available science review, lahars represent a known or suspected risk to Seattle, as per WAC 365-190-080(4)(b)(i). As such, it is recommended that the mapping in Hoblitt et al., 1998, fully described in Exhibit A, be used to designate areas that could be at risk from lahars.

Lahar hazards in Seattle are best addressed though education and emergency management planning. A warning system combined with public education should provide citizens sufficient time to evacuate potential lahar hazard areas, limiting potential impacts. The U.S. Geological Survey is the authoritative research organization regarding volcanic hazards and is therefore reled upon as the source for designation and mapping.

Updating Designations

For hazards where there may be updates from specific reliable sources, the proposed ordinance authorizes the Director to update the designations using sources set out in the ordinance. These updates will be by Director's Rule. For hazards where the presence or absence of the hazard is currently classified as unknown, Section 4 of the ordinance directs the Director to bring new information to the City Council for consideration of whether to change the designation. Subsection 25.09.030A is proposed to be amended to distinguish between maps that are advisory and the new geologic hazard areas that are designated by map.

Current Emergency Management Planning Related to Seismic and Volcanic Hazards
Emergency management techniques represent an effective way to manage risk from seismic and volcanic hazards. Seattle is largely built out and many areas that may be considered at risk from these hazards are already fully developed. The Seattle Office of Emergency Management (http://www.seattle.gov/emergency/) works to mitigate the risk from all types of hazards, including those being considered in this proposal. The Office has led the development of a number of studies, plans and actions that help to prepare citizens and to minimize the risk from hazards. The following is a summary of several of these efforts. The continuing work of this office and other branches of local, state and federal governments to continue to work to understand and mitigate the risk from seismic and volcanic is essential.

Seattle Disaster Readiness and Response Plan
The purpose of this 2003 plan is to explain how the City would lead the response to a major disaster. The mission is to provide all of Seattle's residents, property owners, businesses and institutions, government departments and commissions, and emergency support organizations with a comprehensive emergency management system. To view this plan go to: http://www.seattle.gov/emergency/library/Seattle_Disaster_Readiness_And_Response_Plan.pdf.

Seattle Hazard Identification & Vulnerability Analysis (SHIVA)
This 2004 document provides a narrative assessment of the history of hazards in Seattle and the city's exposure to them. It is a tool that is being used to build an emergency plan around the most dangerous disasters the city faces, including seismic and volcanic hazards. The plan can be viewed by going to http://www.seattle.gov/emergency/library/SHIVA.pdf.

Seattle All-Hazards Mitigation Plan
The 2004 Seattle All-Hazards Mitigation Plan builds off of the findings of the SHIVA and represents the city's first comprehensive effort to describe mitigation efforts across city departments and to develop an integrated mitigation strategy. The plan emphasizes mitigation of city-owned and operated facilities and infrastructure. It also includes reference to mitigation efforts undertaken by related public, quasi-public, and private entities. Natural hazards, in particular, are emphasized in this plan. For example, the plan rates the risk from various hazards and presents methods for mitigating their impact (see Sections 2.4 and 2.5). The plan can be viewed by going to
http://www.seattle.gov/emergency/library/Haz%20Mit%20Plan%20Feb%2004.pdf

Project Impact
Project Impact is a public-private partnership whose overall goal is to make our communities more resistant to the damaging effects of disasters. The Project encourages people to take action before a disaster occurs through initiatives promoting safer homes, schools, businesses, and better earthquake and landslide hazard mapping. More information about Project Impact can be found at http://www.seattle.gov/projectimpact.

IV. Recommendation

The proposed amendments will promote the public interest by designating additional geologically hazardous areas in accordance with the Growth Management Act. This will help to inform the citizens of Seattle about the risks and hazards inherent in living and working here and meets the requirements of the Central Puget Sound Growth Management Hearings Board. DPD recommends that the proposed amendments be approved.

City of Seattle

Gregory J. Nickels, Mayor

Office of the Mayor

February 27, 2007

Honorable Nick Licata
President
Seattle City Council
City Hall, 2nd Floor

Dear Council President Licata:

I am pleased to transmit the attached proposed Council Bill to amend Seattle's Environmentally Critical Areas (ECA) regulations to designate additional geologic hazard areas. This legislation addresses the issues raised in the Final Order and Decision of the Central Puget Sound Growth Management Hearings Board on the appeal of the City's new ECA ordinance enacted in May 2006 (CPSGMHB Case No. 06-3-0024 Seattle Audubon Society, Yes for Seattle, Heron Habitat Helpers and Eugene D. Hoglund v City of Seattle). The order and decision requires Seattle to designate the Seattle Fault, tsunami and seiche inundation areas, and lahar inundation areas as geologic hazard areas in accordance with the state Growth Management Act. The City's deadline for responding to the Hearings Board is April 11, 2007.

The proposal is based on a review of the best available science for geologic hazard areas in Seattle. Key recommendations are to designate as geologic hazards:

- the Seattle Fault Zone
- areas at risk from tsunamis (a series of waves caused by a sudden disturbance that vertically displaces water) in Seattle's marine waters and Lake Washington
- areas at risk from lahars (a gravity-driven mixture of sediment and water that originates from the flanks of a volcano) in the Duwamish River and
- areas at risk from seiches (a series of standing waves contained in an enclosed body of water) in Seattle's major waterbodies

The proposal promotes the public interest. Identifying these areas will help to inform the citizens of Seattle about the risks and hazards inherent in living and working in the city and will satisfy the requirements of the Central Puget Sound Growth Management Hearings Board. Thank you for your consideration of this legislation. Should you have questions, please contact Miles Mayhew at 615-1256.

Sincerely,

GREG NICKELS
Mayor of Seattle

cc: Honorable Members of the Seattle City Council

600 Fourth Avenue, 7th Floor, P.O. Box 94749, Seattle, WA 98124-4749
Tel: (206) 684-4000, TDD: (206) 684-8811 Fax: (206) 684-5360, Email: mayors.office@seattle.gov

Miles Mayhew/mm/esb
DPD - Geologic Hazard Areas ORD.doc
February 15, 2007
Version #2a

ORDINANCE _______________

AN ORDINANCE relating to environmentally critical areas, amending Seattle Municipal Code Sections 25.09.015, 25.09.020, and 25.09.030 to address the findings of the Central Puget Sound Growth Management Hearings Board.

WHEREAS, the Central Puget Sound Growth Management Hearings Board upheld the appeal of Ordinance 122050 with respect to designating certain seismic hazards (the Seattle Fault zone area, areas susceptible to tsunami inundation, and areas susceptible to seiches) and volcanic hazards (areas susceptible to inundation by lahars or related flooding from volcanic activity on Mount Rainier); and

WHEREAS, the Central Puget Sound Growth Management Hearing Board denied the appeal of Ordinance 122050 with respect to requiring additional regulations to protect those seismic and volcanic hazard areas; and

WHEREAS, the City of Seattle has engaged in public participation and has included the best available science in designating these seismic and volcanic hazard areas, has considered the Guidelines adopted by the Washington State Department of Community Trade and Economic Development for designating geologically hazardous critical areas, and has considered the goals of the Growth Management Act, all as set out in the Supplemental Best Available Science Report for Geologically Hazardous Areas, attached as Exhibit A, and in the Director's Report; NOW, THEREFORE,

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. Subsection A of Section 25.09.015 of the Seattle Municipal Code, which Section was enacted by Ordinance 122050, is amended as follows:

25.09.015 Application of chapter.

A. This chapter applies to any development, as defined in Section 25.09.520, or platting carried out by any person on publicly or privately owned parcels containing an environmentally critical area or buffer, <u>except that parcels that are solely within seismic or volcanic hazards areas,</u>

as defined in Sections 25.09.020 A5 and 25.09.020 A6, and that are not liquefaction-prone areas are subject only to Sections 25.09.010, 25.09.017 A, B, C and F, 25.09.020, and 25.09.030.

Section 2. Section 25.09.020 of the Seattle Municipal Code, which Section was last amended by Ordinance 122050, is amended as follows:

25.09.020 Environmentally critical areas definitions.

The following are environmentally critical areas ((~~regulated~~))designated by this chapter: geologic hazard areas, steep slope areas, flood-prone areas, wetlands, fish and wildlife habitat conservation areas, and abandoned landfills.

A. Geologic Hazard Areas and Steep Slope Areas.

1. Geologic hazard areas are liquefaction-prone areas,((~~and~~)) landslide-prone areas, seismic hazards areas and volcanic hazard areas described in subsections 2, ((~~and~~))3, 5 and 6. Landslide-prone areas include steep slope areas. Steep slope areas that are regulated for additional erosion hazards are described in subsection 4. ((~~Seismic hazards are addressed in subsection 5.~~))

2. Liquefaction-prone Areas. Liquefaction-prone areas are areas typically underlain by cohesionless soils of low density, usually in association with a shallow groundwater table, that lose substantial strength during earthquakes.

3. Landslide-prone Areas. The following are landslide-prone areas:

a. Known landslide areas identified by documented history, or areas that have shown significant movement during the last ten thousand (10,000) years or are underlain by mass wastage debris deposited during this period; or

b. Potential landslide areas:

(1) Those areas that are described as potential slide areas in "Seattle Landslide Study" (Shannon & Wilson, 2000((~~,~~)) and 2003)((~~, or as are more accurately mapped~~)).

(2) Areas with indications of past landslide activity, such as landslide headscarps and sidescarps, hummocky terrain, areas with geologic conditions that can promote earth movement, and areas with signs of potential landsliding, such as springs, groundwater seepage, and bowed or backtilted trees.

(3) Areas with topographic expression of runout zones, such as fans and colluvial deposition at the toes of hillsides.

(4) Setbacks at the top of very steep slopes or bluffs, depending on soil conditions.

(5) Slopes with an incline of forty (40) percent or more within a vertical elevation change of at least ten feet (10').

For the purpose of this definition, a slope is measured by establishing its toe and top and averaging the inclination over at least ten feet (10') of elevation difference.

Also for the purpose of this definition:

(a) The "toe" of a slope means a distinct topographic break in slope that separates slopes inclined at less than forty percent (40%) from slopes inclined at forty percent (40%) or more. Where no distinct break exists, the "toe" of a slope is the lower-most limit of the area where the ground surface drops ten feet (10') or more vertically within a horizontal distance of twenty-five feet (25'); and

(b) The "top" of a slope is a distinct topographic break in slope that separates slopes inclined at less than forty percent (40%) from slopes inclined at forty percent (40%) or more. Where no distinct break exists, the "top" of a slope is the upper-most limit of the area where the ground surface drops ten feet (10') or more vertically within a horizontal distance of twenty-five feet (25').

(6) Areas that would be covered under one of subsections (2) to (5), but where the topography has been previously modified through the provision of retaining walls or non-engineered cut and fill operations;

(7) Any slope area potentially unstable as a result of rapid stream incision or stream bank erosion.

4. Steep Slope Areas. Steep slope areas are areas with a slope described in subsection A3b(5) above; provided that ((~~the area is only a landslide prone area~~)) when such a slope is on a parcel in a Downtown zone or highrise zone, the area is designated only as a landslide prone area.

5.((~~There is a known risk from a seismic events in Seattle and the surrounding region. Subsection 1-4 identify areas that constitute a particularly high risk to safety and welfare from such events and are therefore regulated as environmentally critical areas. The risks associated with seismic hazards in the remainder of the City are regulated by the Building Code (SMC Title 22) and not by this Ordinance [Chapter].~~))

Seismic Hazard Areas.

In addition to liquefaction-prone areas described in subsection 2 above, seismic hazard areas are the following:

a. Areas of the City subject to ground shaking from seismic hazards that are addressed by the Building Code (SMC Title 22).

b. The Seattle Fault zone as delineated in Troost et al., 2005, *The geologic map of Seattle, a progress report, U.S. Geological Survey, Open-file report 2005-1252* or as the Director determines is more accurately mapped by the U.S. Geological Survey, as set out in a Director's Rule.

c. For tsunamis the waterbody of Lake Washington and for tsunamis and tsunami inundation, the water body and land area as shown in Walsh, et al., 2003, *Tsunami hazard map of the Elliott Bay area, Seattle, Washington: Modeled tsunami inundation from a Seattle Fault earthquake, Washington State Department of Natural Resources and National Oceanic and Atmospheric Administration. Washington Division of Geology and Earth Resources Open File Report 2003-14*, or as the Director determines are more accurately mapped by the National Oceanic and Atmospheric Administration, the U.S. Geological Survey or the Washington State Department of Natural Resources, as set out in a Director's Rule.

d. The shoreline and upland areas surrounding Lake Washington are classified as an unknown risk from tsunamis under WAC 365-190-080 (4)(b)(iii).

e. For seiches, the waterbodies of Elliot Bay, Lake Union and Lake Washington.

f. The shoreline and upland areas surrounding the waterbodies in subsection (d) are classified as an unknown risk from seiches under WAC 365-190-080 (4)(b)(iii)

6. Volcanic Hazard Areas. Volcanic hazard areas are areas subject to inundation by lahars or related flooding resulting from volcanic activity on Mount Rainier, as delineated by the U.S. Geological Survey in Hoblitt, et.al, 1998, *Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428*, or as the Director determines are more accurately mapped by the U.S. Geological Survey, as set out in a Director's Rule.

***

Section 3. Subsection 25.09.030 A, which was enacted by Ordinance 122050, is amended as follows:

25.09.030 Location of environmentally critical areas and buffers.

A. Environmentally critical areas are defined in Section 25.09.020, and buffers are described in Sections 25.09.160, 25.09.180, and 25.09.200B. Environmentally critical areas are mapped whenever possible. Except for the maps adopted as designations for geologically hazardous areas in subsections 25.09.020 A5 and 6, ((~~T~~))these maps are advisory. The Director may update or amend the maps by Director's Rule.

***

Section 4. When the Director of the Department of Planning and Development finds the best available science is available to determine the presence or absence of a geologic hazard that is currently classified as an unknown risk, the Director shall present that science to the City Council.

Section 5. This ordinance shall take effect and be in force thirty (30) days from and after its approval by the Mayor, but if not approved and returned by the Mayor within ten (10) days after presentation, it shall take effect as provided by Municipal Code Section 1.04.020.

Passed by the City Council the ____ day of _________, 2007, and signed by me in open session in authentication of its passage this _____ day of __________, 2007.

____

President __________of the City Council

Approved by me this ____ day of _________, 2007.

____

Gregory J. Nickels, Mayor

Filed by me this ____ day of _________, 2007.

____

City Clerk

(Seal)

Exhibit A: Supplemental Best Available Science Report For Geological Hazard Areas

Seattle City Council

PUBLIC HEARING SIGN-UP SHEET

Proposed CAO Ordinance Amendments

(NAME OF ISSUE)

03/22/07

(DATE) (TIME)

INFORMATION ON THIS SIGN-UP SHEET IS PUBLIC RECORD
(PLEASE PRINT)

#	NAME	ORGANIZATION	(OPTIONAL) ADDRESS	ZIP	(OPTIONAL) PHONE	(OPTIONAL) FAX
	GENE HOGLUND	CITIZEN	3503 30TH AW	98199	3780722	

STATE OF WASHINGTON – KING COUNTY

--ss.

209905 No.

CITY OF SEATTLE,CLERKS OFFICE

Affidavit of Publication

The undersigned, on oath states that he is an authorized representative of The Daily Journal of Commerce, a daily newspaper, which newspaper is a legal newspaper of general circulation and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continuously as a daily newspaper in Seattle, King County, Washington, and it is now and during all of said time was printed in an office maintained at the aforesaid place of publication of this newspaper. The Daily Journal of Commerce was on the 12th day of June, 1941, approved as a legal newspaper by the Superior Court of King County.

The notice in the exact form annexed, was published in regular issues of The Daily Journal of Commerce, which was regularly distributed to its subscribers during the below stated period. The annexed notice, a

CT:122370 ORDINANCE

was published on

04/11/07

The amount of the fee charged for the foregoing publication is the sum of $ 355.73, which amount has been paid in full.

Subscribed and sworn to before me on

04/11/07

Notary public for the State of Washington, residing in Seattle

JENNIFER A. PATZER
COMMISSION EXPIRES
NOTARY
PUBLIC
OCT. 24, 2007
STATE OF WASHINGTON

Affidavit of Publication

State of Washington, King County

City of Seattle

ORDINANCE 122370

AN ORDINANCE relating to environmentally critical areas, amending Seattle Municipal Code Sections 25.09.015, 25.09.020, and 25.09.030 to address the findings of the Central Puget Sound Growth Management Hearings Board.

WHEREAS, the Central Puget Sound Growth Management Hearings Board upheld the appeal of Ordinance 122050 with respect to designating certain seismic hazards (the Seattle Fault zone area, areas susceptible to tsunami inundation, and areas susceptible to seiches) and volcanic hazards (areas susceptible to inundation by lahars or related flooding from volcanic activity on Mount Rainier); and

WHEREAS, the Central Puget Sound Growth Management Hearing Board denied the appeal of Ordinance 122050 with respect to requiring additional regulations to protect those seismic and volcanic hazard areas; and

WHEREAS, the City of Seattle has engaged in public participation and has included the best available science in designating these seismic and volcanic hazard areas, has considered the Guidelines adopted by the Washington State Department of Community Trade and Economic Development for designating geologically hazardous critical areas, and has considered the goals of the Growth Management Act, all as set out in the Supplemental Best Available Science Report for Geologically Hazardous Areas, attached as Exhibit A, and in the Director's Report; NOW, THEREFORE,

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. Subsection A of Section 25.09.015 of the Seattle Municipal Code, which Section was enacted by Ordinance 122050, is amended as follows:

25.09.015 Application of chapter.

A. This chapter applies to any development, as defined in Section 25.09.520, or platting carried out by any person on publicly or privately owned parcels containing an environmentally critical area or buffer, except that parcels that are solely within seismic or volcanic hazards areas, as defined in Sections 25.09.020 A5 and 25.09.020 A6, and that are not liquefaction-prone areas are subject only to Sections 25.09.010, 25.09.017 A, B, C and F, 25.09.020, and 25.09.030.

Section 2. Section 25.09.020 of the Seattle Municipal Code, which Section was last amended by Ordinance 122050, is amended as follows:

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The following are environmentally critical areas ((~~regulated~~)) designated by this chapter: geologic hazard areas, steep slope areas, flood-prone areas, wetlands, fish and wildlife habitat conservation areas, and abandoned landfills.

A. Geologic Hazard Areas and Steep Slope Areas.

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(5) Slopes with an incline of forty (40) percent or more within a vertical elevation change of at least ten feet (10').

For the purpose of this definition, a slope is measured by establishing its toe and top and averaging the inclination over at least ten feet (10') of elevation difference.

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5.((~~There is a known risk from a seismic events in Seattle and the surrounding region. Subsection 1-4 identify areas that constitute a particularly high risk to safety and welfare from such events and are therefore regulated as environmentally critical areas. The risks associated with seismic hazards in the remainder of the City are regulated by the Building Code (SMC Title 22) and not by this Ordinance [Chapter].~~))

Seismic Hazard Areas.

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a. Areas of the City subject to ground shaking from seismic hazards that are addressed by the Building Code (SMC Title 22).

b. The Seattle Fault zone as delineated in Troost et al., 2005. *The geologic map of Seattle, a progress report. U.S. Geological Survey. Open-file report 2005-1252* or as the Director determines is more accurately mapped by the U.S. Geological Survey, as set out in a Director's Rule.

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d. The shoreline and upland areas surrounding Lake Washington are classified as an unknown risk from tsunamis under WAC 365-190-080 (4)(b)(iii).

e. For seiches, the waterbodies of Elliot Bay, Lake Union and Lake Washington.

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Section 3. Subsection 25.09.030 A, which was enacted by Ordinance 122050, is amended as follows:

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A. Environmentally critical areas are defined in Section 25.09.020, and buffers are described in Sections 25.09.160, 25.09.180, and 25.09.200B. Environmentally critical areas are mapped whenever possible. Except for the maps adopted as designations for geologically hazardous areas in subsections 25.09.020 A5 and 6, ((~~T~~))these maps are advisory. The Director may update or amend the maps by Director's Rule.

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Section 4. When the Director of the Department of Planning and Development finds the best available science is available to determine the presence or absence of a geologic hazard that is currently classified as an unknown risk, the Director shall present that science to the City Council.

Section 5. This ordinance shall take effect and be in force thirty (30) days from and after its approval by the Mayor, but if not approved and returned by the Mayor within ten (10) days after presentation, it shall take effect as provided by Municipal Code Section 1.04.020.

Passed by the City Council the 2nd day of April, 2007, and signed by me in open session in authentication of its passage this 2nd day of April, 2007.

Nick Licata

President of the City Council

Approved by me this 6th day of April, 2007.

Gregory J. Nickels, Mayor

Filed by me this 6th day of April, 2007.

(Seal) Judith Pippin

City Clerk

Exhibit A: Supplemental Best Available Science Report For Geological Hazard Areas

See City Clerk for Exhibit

Publication ordered by JUDITH PIPPIN, City Clerk

Date of publication in the Seattle Daily Journal of Commerce, April 11, 2007.

4/11(209905)

residential schedule be modified/ adjusted. Additional requests, if any, are stated in the petition, a copy of which is attached to this notice.

2. You must respond to this summons and petition by serving a copy of your written response on the person signing this summons and by filing the original with the clerk of the court. If you do not serve your written response within 20 days (or 60 days if you are served outside of the State of Washington) after the date this summons was served on you, exclusive of the day of service, the court may enter an order of default against you, and the court may, without further notice to you, enter an order regarding adequate cause and a decree to modify/adjust the custody decree/ parenting plan/residential schedule and providing for other relief requested in the petition. If you serve a notice of appearance on the undersigned person, you are entitled to notice before an order of default or a decree may be entered.

3. The court shall deny the petition unless it finds that adequate cause for hearing the petition is established, in which case it shall set a date for hearing on an order to show cause why the requested order or modification should not be granted. Temporary residential placement or custody is being sought. If adequate cause is found, the court may proceed immediately to hear the motion for temporary placement/custody or may continue the matter to a later time.

4. You may file an opposing declaration to show that there is not adequate cause to hold a full hearing. If you do not file an opposing declaration or respond and the court finds that adequate cause exists, the court may enter an adequate cause order and an order modifying/adjusting the custody decree/parenting plan/residential schedule without notice to you pursuant to RCW 26.09.270.

5. Your written response to the summons and petition must be on form WPF DR 07.0200, Response to Petition for Modification/ Adjustment of Custody Decree/ Parenting Plan/Residential Schedule. This form may be obtained by contacting the clerk of the court at the address below, by contacting the Administrative Office of the Courts at (360) 705-5328, or from the Internet at the Washington State Courts homepage: http://www.courts.wa.gov/forms

6. If this action has not been filed with the court, you may demand that the petitioner file this action with the court. If you do so, the demand must be in writing and must be served upon the person signing this notice. Within 14 days after you serve the demand, the petitioner must file this action with the court, or the service on you of this notice and motion will be void.

7. If you wish to seek the advice of an attorney in this matter, you should do so promptly so that your written response, if any, may be served on time.

8. One method of serving a copy of your response on the petitioner is to send it by certified mail with return receipt requested.

This summons is issued pursuant to Superior Court Civil Rule 4.1 of the State of Washington.

Dated: March 26, 2007.

ALISA MAPLES, WSBA #25735, Attorney for Respondent.

File original of your response with the Clerk of the Court at: Clerk of the Court, King County Superior Court, E609, King Co. Courthouse, 516 Third Avenue, Seattle, WA 98104.

Serve a copy of your response on: ALISA MAPLES, Law Office of Alisa Maples, 15 S. Grady Way, Suite 400, Renton, WA 98055. ph 425-228-3628.

5/16(209872)

SAN DIEGO COUNTY CITATION FOR ADOPTION CALIFORNIA SUPERIOR COURT NO. AN12275

SUPERIOR COURT OF California, County of San Diego, North County Division, 325 S. Melrose Dr., Vista, CA 92081-6627.

In the Matter of Jenalyn Faulkner Murray. Case Number

Representatives or the Persona[l] Representatives' attorney at th[e] address stated below a copy o[f] the claim and filing the origina[l] of the claim with the court. The claim must be presented within the later of: (1) Thirty days after the Personal Representatives served or mailed the notice to the creditor as provided under RCW 11.40.020(3); or (2) four months after the date of first publicatio[n] of the notice. If the claim is not presented within this time frame the claim is forever barred, excep[t] as otherwise provided in sectio[n] 11 of this act and RCW 11.40.060 This bar is effective as to claim